The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

VOL. XXVII. August 20th, 1932 No. 686

Notes and Comments

The Conversion Scheme

THE foundation of trade revival has been well and truly laid by the success of the Conversion Scheme. All expectations, official and unofficial alike, have been left far behind by the published result of the first and most important stage of that gigantic operation. The amount of five per cent. War Loan converted to a three-and-a-half per cent. basis is no less than £1,850,000,000, which is equal to 88.6 per cent. of the whole issue. When the figures are made up it will be found that substantially over ninety per cent. has been converted. How astonishing is this achievement is shown by a comparison with the famous Goschen Scheme in 1889, which resulted in the conversion of nearly eighty per cent. of stock, amounting in the aggregate to about a quarter of the War Loan issue. The holding of War Loan is so widespread that the response to the Government's appeal for conversion can fairly be described as a national effort. Accordingly, the question now arises, "What is the Government going to do in return?" The nation has patriotically sacrificed over £20,000,000 a year. It has shouldered this additional burden on the implicit understanding that the Government will enforce economy and reduce taxation. As things stand at the present moment the ordinary man has been hit twice by the policy adopted by the Government to deal with the economic crisis. He is having his dividends reduced at a time when he is called upon to pay heavier taxation. The obvious sequel to the conversion operation is a substantial cut in the income tax, and on that count the Government is very definitely on its trial. For the second time within a year the nation has unmistakably given a mandate for national economy, without which there is no hope of reduced taxation and little chance of a permanent return to prosperity.

Strengthen the Home Markets

THE British Empire is reported to offer the best foreign market for United States chemicals and allied products. Throughout the last few years exports of chemical products from the United States to the British Empire have accounted for 40 per cent. or more of the total United States exports of chemicals and even in 1931 reached $59,000,000 or about £12,000,000 in value. Together, the United Kingdom and Canada have accounted for 30 or more per cent. of the trade. Until 1928 the United Kingdom was the largest buyer, followed by Canada, but in that year, Canada supplanted the mother country as the outstanding single purchaser and has maintained that position. Both countries are buyers of large quantities of rosin, turpentine, sulphur and industrial chemicals, as well as highly-finished products such as paints, medicinals and toilet preparations. The United States is proud of its achievement, for the exports of these commodities held up particularly well in 1931 considering the market drop in prices and other adverse conditions of that year. From the point of view of the chemical manufacturer in this country, we have little to rejoice over in reviewing this situation. Rosin, turpentine, sulphur, carbon black and certain other items are necessary for industrial uses in this country for they are to be considered more or less as raw materials, but there is no excuse for British users to go to the United States for $2,440,000 worth of toilet preparations (including laundry soap to the value of $266,000) when there are home manufacturers capable of supplying these needs at equal, if not competive prices, whilst certainly of equal or better quality. On the other hand, coal tar dyes, colours and stains coming into the United Kingdom direct from the United States in 1931 had a total value of only £11,000, a position which reflects the good influence of the Dyestuffs (Imports Regulation) Act. If similar Acts were applied to toilet preparations and certain other commodities of which the ingredients are essentially chemical, there would be many smaller manufacturers in this country who would benefit, for whilst certain toilet preparations are continually in demand there is also a proportion of the population which will demand the luxuries which fall into this category, so long as they have the money with which to purchase.

Food Storage Research.

THERE is increasing recognition of the importance of work done by the Food Investigation Board of the Department of Scientific and Industrial Research. Since the Board was formed in 1917 it has had to undertake much fundamental research, mainly in the lesser-known fields of bio-chemistry, in order to equip itself to make available knowledge on the best methods of food storage. At first, practical men in the food industry were inclined to stand aloof from this application of science to their business, but now they have come to realise that only from scientific understanding of the problems involved can sound advice be given in overcoming everyday difficulties. Much attention has been directed to the successful work done by the board for the better storage of fruit, by its discovery that "brown heart" in apples is due to lack of ventilation in ships' holds. This is being followed up by a more general investigation into ways of maintaining uniform temperature and humidity of atmosphere during a voyage through tropical and temperate waters. The engineering side of the problem is being examined at the National Physical Laboratory; at Cambridge

biological aspects of the matter are under review, and at Ditton a model ship's hold has been set up for large-scale experiments in bulk storage. A receiving laboratory was also set up at Covent Garden Market so that fruit could be examined, and if necessary sent to Cambridge for further study. The work of the board, however, has not been confined to fruit storage. It has studied problems involved in the storage of meat and fish. The great risk in meat cold storage is a development of an unpleasant odour and taste in the fat, and an attempt is being made to discover how far this is due to chemical changes. Already it has been learned that oxidation of fats proceeds in two stages. In the second stage a rancid taste quickly becomes apparent. Successful storage depends on ability to prolong the first, or "induction" period, and here it has been found that light plays an important part. A short exposure to light starts harmful chemical changes that proceed even after the meat has been removed to a dark room.

Metallised Wood

IT is about two years since publicity was first given to the use of metals for the impregnation of wood, as developed at the Kaiser Wilhelm Institut für Eisenforschung. In principle this process makes it possible to open the microscopic pores of the wood so that the individual cells can be filled with molten metal whilst still retaining their original form. The technology of the process is confined to a preliminary treatment of the wood, principally drying, after which it is immersed in molten metal and then exposed to moderate pressure in a closed vessel. If desired, metallisation can be so controlled that impregnation can be carried to the very interior of the wood, or alternatively the surfaces can be impregnated to a greater or less extent, while the inner zone remains untreated. The properties of the new material depend to some extent on the types of wood and metals chosen. The most conspicuous property is the increase in weight; walnut treated with tin, for instance, reaches a specific gravity of 3.83 as compared with 7.28 for tin itself. In the case of pine a specific gravity of 4.83 has been reached, equivalent to two-thirds by volume of metal. Tensile strength is not much affected, but hardness and compression strength are notably improved in proportion to the metal content. In general they become two or three times the value for wood alone; but in the case of antimony-lead alloys, considerably higher values are obtained. The metallised material shows up to special advantage in exposure to moisture or fire. Swelling in moist atmospheres or in water is greatly reduced and even entirely prevented if the wood is strongly metallised. Walnut which previously absorbed 87 grams per 100 c.c. in 24 hours in water at 80°C., absorbed only 4.4 grams per 100 c.c. after metallisation. The metal, of course, rapidly dissipates any heat to which the material may be exposed; nor are any combustible gases formed. After prolonged intense heating, when the metal has flowed from the surface, the wood will begin to glow like charcoal, but it does not otherwise support combustion. Commercial uses have not been forthcoming in any great number, but a wide and useful application for the material has been found in bearings for machinery such as rolling mills. In this instance, the property of the metallised wood of absorbing 3 per cent. by volume of oil under pressure, combined with its own hardness, obviates the necessity for lubricating and of using certain expensive woods that are frequently employed. This feature may possibly hold a great future for the material where inaccessible bearings are concerned or where the contamination of machine-handled products by lubricants is to be eliminated.

The Nitrate Negotiations

OWING to the uncompromising attitude adopted by Chile, agreement on a common policy of action has not been reached at the International Nitrate Conference. An arrangement among the European producers, however, promises to place the industry on a better footing so far as that continent is concerned. While no details are available, it is understood that for a period of several years European exports will be centralised by a board on which Great Britain, Germany and Norway will be represented. This board will control the nitrate industry of all the principal European countries, and home markets (with certain exceptions) will be protected. The board will not regulate prices in the home market, neither is restriction of output to be enforced, it being felt that this production will be automatically adjusted in accordance with home demands and the export quota. A scheme based on these lines appears to be workable, but much depends upon the attitude that Chile may adopt. The great obstacle to an understanding with that country is the enormous stocks of nitrate awaiting shipment. These are estimated to amount to well over 400,000 tons expressed in terms of nitrogen. It is reported that Chile has threatened to dump these stocks on the markets, but the European producers are not inclined to regard this too seriously. Before such a step is taken the banks who finance the Chilean exports have to be consulted, and it is extremely doubtful if their approval can be obtained, for they have already made it known that a period of two years at least is required for the disposal of stocks.

Progress in Dyestuffs

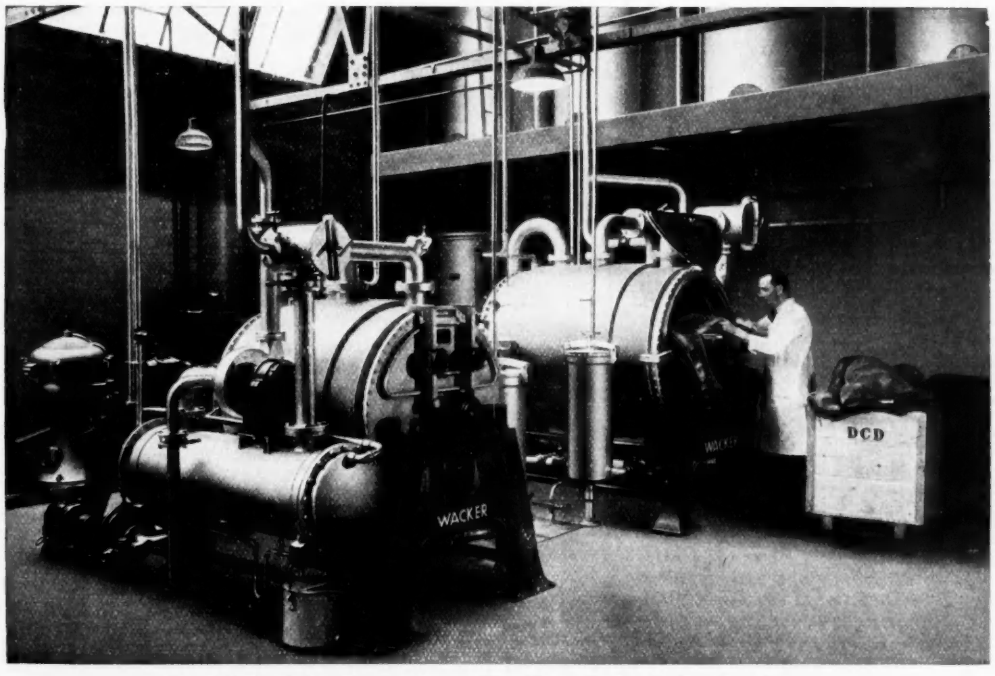
THE progress of the dyestuffs industry is being favoured with a special exhibit at the Science Museum, South Kensington, in connection with the celebration of the museum's 75th birthday, for it so happened that the discovery of mauve by Perkin (1856) almost coincided with the opening of the Science Museum (1857). Dyes, textiles and models are being displayed, through the co-operation and courtesy of a number of industrial concerns. There are finished fabrics of all types; skeins, dyes with various classes of dyestuffs to demonstrate the range of shades available; original samples of artificial allizarine and other compounds prepared by Perkin during his researches; exhibits illustrative of the application of dyes in textile printing, the leather industry and the colouring of paper. Another interesting exhibit relates to the effect of various agencies on the fastness of dyestuffs, where you may see the effect of light, water, washing, chlorine, mineral acid and alkali upon Malachite Green in comparison with one of the Caledon Jade Greens selected as a typical example of a modern fast dye. This special display of progress during the period 1856-1932 remains open until the end of September.

Trichlorethylene in the "Wacker" Cleaning System

By WILLIAM BROWN, M.Sc., A.I.C.

SINCE its inception in England about the middle of the nineteenth century, dry-cleaning has meant the almost general employment of solvents of the benzine or white spirit type with the ever-present nightmare of fire danger because of their ready inflammability. Those associated with the use of these inflammable solvents known only too well the exacting precautions, which have to be taken to combat this fire risk, and quite a number have experienced the futility of the most meticulous attention to them. Many launderers who might have increased their range of activities by combining laundry work with dry-cleaning have hesitated to install the required equipment because of this fire danger, its effect upon insurance costs, and the many government restrictions entailed.

During recent years, the use of non-inflammable solvents for dry-cleaning has shown signs of a growing adoption all over Europe, and there is already in our midst several forms of dry-cleaning, which entirely remove the fire risk. These solvents are not only non-inflammable, but are also highly efficient fire resisters or extinguishers and are used as such by makers of fire-extinguishing appliances. Surely this in itself is an enormous advance over such highly inflammable substances as benzine or white spirit. It must be admitted that the entire removal of fire risk, the sweeping away of Home Office regulations and the absence of the necessity for elaborate fire-quenching equipment by the adoption of a new solvent, provides a ground work for serious consideration.



The "Wacker" Dry Cleaning Plant as installed at the London Laundry, Coventry.

Trichlorethylene as a Cleaning Agent

These new solvents belong to the class of chemicals known as chlor-hydrocarbons, and of these, trichlorethylene is substantiating its claim as the most efficient agent applicable to dry-cleaning. Trichlorethylene is absolutely non-inflammable and non-explosive. It is a very near relation to chloroform and is similar to it in all its properties. It is a heavy liquid and weighs 14.7 lbs. per gallon. It is totally evaporated at 87° C. leaving neither residue nor smell. The commercial product is a pure substance, whose boiling point range lies within 1° C., in contradistinction to the benzine solvents, whole boiling point ranges vary and often have limits to be more than 100 degrees apart, trichlorethylene has no high boiling residue left behind in materials after cleaning, so that there is no difficulty in removing the last trace of solvent. It evaporates rapidly at ordinary temperatures, giving off a heavy non-inflammable vapour. It is stronger in solvent action than benzine; consequently grease is removed quicker and the time of cleaning reduced. It is an excellent solvent for paint, tar and grass stains. Most chlor-hydrocarbons are affected by certain metals, especially iron in presence of moisture, but trichlorethylene is unique in being the most stable and practically unaffected by metals under all conditions.

As a cleaning agent, trichlorethylene can be used with complete safety and perfect success on all textile materials, wool, cotton, silk, artificial silk, linen, carpets, furs, hats and even articles of acetate silk, notwithstanding the well known sensitiveness of this material. The colours of silk goods are distinctly brightened when cleaned with trichlorethylene. Owing to its stability in contact with metals no special precautions are necessary in the selection of materials used in the construction of machines for cleaning by this solvent.

With reference to physiological action, the vapour of trichlorethylene is considerable safer than most of the chlor-hydrocarbons used as dry-cleaning solvents. In common with all the solvents of this class when inhaled in comparatively large quantities, it has a narcotic effect and may produce a state of intoxication. Experience has shown, however, that such condition quickly passes without any injurious after-effect, and in consequence, the employment of this solvent in enclosed type of machine now being widely adopted in cleaning works is almost foolproof. When studying the question of the physiological action of a solvent and its effect on general health, the narcotic or temporary effect is of slight importance in comparison with the toxic and lasting effect, which may result from breathing even small quantities of vapour. In this latter respect, the vapour of trichlorethylene is quite harmless and its inhalation does not produce nausea and vomiting, the ominous symptoms of internal injury. Cases of illness of this nature are entirely unknown in cleaning work using trichlorethylene. It is also remarkable that garments after cleaning with trichlorethylene are completely free from residual odour. This is due to the ease, with which

it is totally evaporated, yet a further advantage due to ease of evaporation is the economy in steam consumption in such processes as drying and distillation.

A Revolution in Dry-Cleaning Methods

The revolution in dry-cleaning methods is gaining impetus everyday, and every day brings fresh proof of the efficiency and superiority of dry-cleaning by use of non-inflammable solvents. These advances have only been made possible as the result of the perseverance and research of the machinery makers. The manner in which the makers of plant for non-inflammable solvent cleaning have adapted their machines to suit the characteristic properties of the solvent and so made this new method commercially competitive with benzine cleaning is a triumph for modern chemical engineering.

The firm of Dr. Alexander Wacker, Ges. für elektrochemische Industrie G.m.b.H., Prinzregententrasse, 20, München, have placed themselves in the footsteps of these advances by the success of their new " Wacker " installation for cleaning by the " Tri " method. The possibilities of trichlorethylene as a dry-cleaning agent have been fully recognised by this firm, who determined to produce a machine specially designed for cleaning by this solvent. The immense strides in the improvement in equipment for use of non-inflammable solvents are clearly evident in the new " Tri " dry-cleaning machines now being produced by the Wacker firm. The word " Tri " is an abbreviation of the name " trichlorethylene." The " Tri " cleaning plants are applicable to the cleaning of all kinds of clothing and textile goods by means of trichlorethylene. This " Tri " system has had quite a large adoption in Germany and France and is now being marketed in England through Petri Brothers, Ltd., 3 Lloyds Avenue, London, E.C.3.

Method of Operation

The " Wacker " machine for " Tri " cleaning is a totally enclosed machine, in which the articles to be treated are cleaned, extracted, dried and deodourised. The washer is divided into two (sometimes several) horizontal compartments and is loaded from the end as with a " Smith " or " Barbe " machine. This division gives an even distribution of the load about the main spindle, a very necessary condition for centrifugal extraction. The loading door is, of course, clamped up to be vapour tight. During the cleaning process, the liquor is in constant circulation, loose impurities being removed by passing the solvent continually through a centrifugal clarifier. After cleaning the liquor is run off from the washer which is then geared up to a high speed and becomes an extractor working on a horizontal axis. This is a great advantage, for the larger portion of solvent held by the load is recovered without use of heat.

After extraction, the machine is slowed down to normal speed and the goods dried by blowing in hot air, which is passed over the machine through a condenser in order to recover the evaporated solivent. At this stage, an outstanding feature of the " Wacker " installation comes into action. Steam is circulated round the outside casing of the machine, which is specially jacketted for the purpose. This jacketting prevents the recondensation of the " Tri " solvent on the walls of the machine, and so reduces the time and temperature of evaporation. Purification of the " Tri " is effected by distillation in a separate still. The economical working of the Wacker installation is shown by a solvent consumption of approximately 10 per cent. of the dry weight of goods being cleaned, but it is possible to reduce this loss in certain cases to 7½ per cent.

Installation at a Midland Laundry

The newest " Wacker " installation in England is now operating at the London Laundry, Coventry, and although it has only been running for a few weeks, it has given every satisfaction and produced results beyond the most ambitious anticipations of C. H. Elson & Sons, Ltd., the proprietors of the London Laundry. This installation is a triumph of engineering, combining a neatness of arrangement with remarkable strength of structure. A series of electric motors of differing horse-power give the various driving speeds necessary for cleaning and extracting. The entire absence of vibration during the extracting process with the washer rotating at 600 r.p.m. is an excellent testimony to the stability of the machine. The Coventry installation consists of two cleaning machines, a small one with a capacity for 50 lbs. work, and a larger machine taking a load of 130 lbs. or 30 suits. An ingenious lay-out of pipe lines for the " Tri " solvent enables the cleaning to be run as an intermittent system of washing and rinsing, or as a continuous system, where the solvent is passed through a centrifugal clarifier throughout the cleaning operation. The solvent " Tri " is stored in neat cylindrical tanks; separate tanks being allotted to pure, centrifuged, dirty and distilled liquid. It is noteworthy that during the whole operation the temperature never rises above 65° C., while the steam line is fitted with a reducing valve set at 10 lbs. per sq. in. The Coventry installation is an example of the " Wacker " equipment " M," where an exclusive double motor drive is used, one electric motor for the cleaning process and a second one for centrifuging; no belting or gearing is employed. The smaller cleaning motor drives the drum shaft through a worm, while the larger centrifuging motor drives directly on the main shaft, each motor being brought into action at will by a reversible coupling. The centrifuging motor can be slowly brought up to speed so that the washer gradually reaches the speed necessary for extraction. The whole drive occupies very small space and is extremely neat in the absence of belts and gives a clear view of the complete installations.

Two other methods of driving are available on the "Wacker" machines. Equipment "R" is fitted for belt driving, with the usual arrangement of belt and pulleys for reversing and speed variation, while equipment "K" embodies a completely enclosed system of gearing running in oil and driven either by a single transmission belt or motor. The " Wacker " machines are available in eight sizes ranging from the smallest of approximately 25 lbs. capacity to the largest of 240 lbs. capacity dry weight of work.

Such are a few of the details of the " Wacker " dry-cleaning installations. Any cleaner or launderer, who wishes to be up-to-date and at the same time, make a profitable investment, cannot afford to ignore the claims of these machines.

Practical Spectroscopy

New Aids for the Analytical Laboratory

CATALOGUES issued by Adam Hilger, Ltd., of London, describe two new laboratory aids for the practical spectroscopist, both of which are applicable primarily to the ratio quantitative spectroscopy devised bp Dr. S. Judd Lewis (" Chemistry and Industry," 1932, *51*, 271-274). " Specpure " substances are salts and solutions of metals of the highest purity, spectroscopically controlled. Besides their application to quantitative chemical analysis by the emission spectrum they may serve many purposes in chemical and physical research, their purity approaching in some cases that accepted in modern atomic weight determinations. In Dr. Judd Lewis's method the proportion of a minute amount of a minor element in a substance is determined spectrographically in terms of ratio to a dominant element in the substance, by comparison of a spectrum of the substance with one of a ratio powder containing the same dominant element (*e.g.*, calcium) in association with a small known proportion of the minor element *e.g.*, zinc) to be determined. The proportion of the dominant element in the specimen can, of course, be determined chemically. A number of standardised ratio powders of differing composition suitable for various types of analysis (plant and animal fibres, soil analysis, biological ashes, etc.) are listed, but special ones can be compounded from the " Specpure " solutions to satisfy any routine or individual problems.

" Specpure " ratio substances are obtainable in four forms:—(1) Ratio powders in which certain elements are mixed in fixed proportions with the major component; (2) " Specpure " solid salts, of the highest purity; (3) Solutions containing precisely 10 grams of highly pure anhydrous salt (usually chloride) in 100 c.c.; (4) Ratio solutions (suitable for compounding ratio powders), standardised to contain precisely one gram of a metallic element (in the form of chloride) in 100 c.c. The ratio solutions may be mixed, volumetrically to " synthesise " a given ash or other material; the " Specpure " substances will be found the most convenient to use in other methods of quantitative spectrum analysis.

Improved Adhesives for Industry

Final Report of the Adhesives Research Committee

THE Adhesives Research Committee which was appointed in 1919 to continue the work of the Adhesives Committee of the Conjoint Board of Scientific Societies, have now submitted their third and final report,* which incorporates an account of work done subsequent to the presentation of their second report published in 1926. This present report describes the final stages of the work conducted by Mr. W. D. Douglas and Miss C. B. Pettifor at the Royal Aircraft Establishment on the mechanical testing of timber-glue joints (Appendix I); it also records further progress made by the late Professor S. B. Schryver, F.R.S., and his collaborators at the Imperial College of Science and Technology, in their researches into the chemistry of gelatin (Appendix II), and by Professor J. W. McBain, F.R.S., with Dr. W. B. Lee, at Bristol University and later at Stanford University, U.S.A., in the investigation of the Nature of Adhesion (Appendix III).

The origin of the committee's work lay in the anticipated shortage towards the end of the great war of materials for gluing, due in the first place to the greatly increased demand for aircraft production, and in the second place to the need for conserving food supplies, which limited the amount available of casein for the manufacture of cements. The general objects in view were therefore to make better use of existing sources of raw material by improvements in manufacture, etc., and to discover if possible new sources of raw material. In the latter connection work by Professor Schryver on the production of an adhesive from the castor bean gave promising results. While the process has not proved commercially practicable at current prices the work is on record, and may prove useful at some later date. Dr. Kernot's work on fish, however, opened out a bigger prospect. As is well known, fish glues have never enjoyed the high reputation of glue made from the hides and bones of land animals on account of their disagreeable odour and their tendency to absorb moisture. As described in the second report of the committee, Dr. Kernot has shown how to produce from fish skins odourless and non-hygroscopic glues which compare favourably with high grade animal glues in adhesive power. Improved products were also obtained from other fish offal. The improved production of fish glue is important to this country on account of the existence of a large fishing industry and Dr. Kernot's work accordingly adds considerably to our potential sources of raw material for high grade glue.

Crystalline Substances as Adhesives

Dealing with adhesives and adhesive action (Appendix III) it is stated that entirely new ground has been broken in the use of pure crystalline substances as "adhesives" for the purpose of elucidating the nature and laws of adhesion. This, together with some later investigations by Hardy and Nottage ("Proc. Roy. Soc.," A, 1928, *118*, 223), in which they also used pure solids, has already yielded important information relating to the adhesion of pure chemical substances to metals glass, quartz and even wood.

There is a close connection between adhesion and the architecture of the molecule, both in the case of pure liquids and pure solids. It may be said that, in general, aromatic compounds tend to give stronger joints than the aliphatic compounds. Thus the *n*-fatty acids and their related alcohols and many other long-chain compounds,that is, including those pure substances which are good lubricants, are all poor adhesives. On the other hand, many aromatic compounds such as coumarin, triphenyl carbinol, aurin, rosolic acid and trinitrotoluene are relatively strong adhesives. Many of the stronger joints were given by substances containing OH and CO groups. Pure coumarin applied molten and subsequently allowed to solidify *in situ* is capable of producing relatively strong joints either between metals or wood. The joint strength of certain crystalline substances such as saligenin may be increased several fold by heating the substances above the melting point. Resinification increases strength and joint strength which seems to run parallel with the extent of the resinification. Based upon a comparison of matter in the crystalline and resinous states it has been concluded that disorderly structure (on resinification) increases strength and joint strength.

Strong joints of the order of 1 ton per sq. in. may be prepared by employing "overheated" glycollic acid as the adhesive between plane metal surfaces; this represents the strongest joint of this type so far discovered. It is worth noting that glycollide can be prepared by heating glycollic acid and that the well-known strong adhesive shellac has also probably a lactide structure. The day would appear to be approaching when it will be possible to predict with some degree of certainty whether a given substance of known chemical constitution and physical properties will be a good adhesive for a given material. In illustration it has been found that the dyes, aurin and rosolic acid, which are indirectly related to triphenyl carbinol (a good adhesive for metal), are under certain conditions (exceedingly thin films between optically polished surfaces) also good adhesives for metals.

The following compounds are pure solid substances which may be used as adhesives; they are roughly divided into three groups according to the strength of joints obtained with the various metals:—

STRONG.—Coumarin, triphenyl, carbinol, glycollic acid ("overheated"), saligenin (resinified), glucose, Rochelle salt, sulphur, aurin, rosolic acid, malachite green, *p*-hydroxybenzaldehyde.

MEDIUM.—*pp'*-diaminodiphenylmethane, thallium salicylaldehyde, benzophenone, benzil, 2 : 4 : 6 : trinitrotoluene, salicin, cholesterol, uric acid, azelaic acid, dihydroxystearic acid.

WEAK.—*n*-fatty acids, cetyl alcohol, ethyl--R-carbinols, a saturated aliphatic hydrocarbon, sodium palmitate m.p. 316°), penanthrene, elaidic acid, α-methyl-*d*-glucoside, thallium maleate, *p*-nitraniline, *p*-toluidine, β-naphthol, catechin, cinnamic acid, camphene, saligenin (heated only to its m.p.), glycollic acid.

Effect of "Overheating"

In the present investigation quantitative determinations have been made of the strength of joints (in tension and shear) of nearly one hundred pure chemical substances, both solids and liquids, of the most diverse type. Care was taken to heat the metal test-pieces and the solid substance used as adhesive at a temperature only just above the melting point of the latter. The test-pieces were then pressed together with a sliding motion to squeeze out the surplus liquid and any possible bubbles. "Overheating," that is, heating certain substances many degrees above their melting point was found to have a general influence in increasing the strength of joint. This is strikingly seen with saligenin where heating to 43° C. above the melting point for an hour increased the joint strength nearly sevenfold. In this case the saligenin distinctly resinified, but with Rochelle salt the chief effect observable is increase in viscosity as the water of crystallisation is expelled. The increase of joint strength with saligenin seems to go parallel with extent of resinification and may perhaps be only limited by the ultimate infusibility of the resulting material. Heating too long, or at too high a temperature, converts it to infusible solid similar to commercial bakelite "C" but much more brittle. Salicin also resinifies.

Preliminary experiments demonstrated clearly that pure glycollic acid, after heating to the melting point and allowing to set, is a very poor adhesive for joining metal surfaces. However, if the pronounced adhesive properties of shellac for metals are in any way connected to its probable lactide structure, one might expect that a substance such as glycollide (which can be obtained by heating glycollic acid) would also be a strong adhesive for uniting metal surfaces. This expectation drawn from the above considerations was confirmed by the following tests with two specimens of "overheated" glycollic acid. One sample was prepared by heating pure glycollic acid very gradually to 150° C. and maintaining it at that temperature for several hours, the whole operation taking about one day, and a hard compact product was obtained on cooling. The remarkable strength of nearly 1 ton per sq. in.

*Third and Final Report of the Adhesives Research Committee. H.M. Stationery Office, price 2s. 6d.

here obtained with very smooth (but not optically polished) surfaces, represents the strongest joint of this type hitherto discovered, starting with a pure chemical substance as adhesive. In this respect "overheated" glycollic acid fully rivals the strength of joint obtainable with many of the recognised adhesives such as marine glue, high grade rosin, ester gum and bakelite "A."

Tests on Pure Substances

Pure stearic acid, cetyl alcohol, palmitic acid, cerotic acid and elaidic acid exemplify good lubricants whose joints are weak both in tension and in shear. Both stearic acid and cetyl alcohol give joints which are twice as strong when the film of adhesive is made specially thin by the use of optically plane test-pieces. For example, the values for stearic acid with nickel were 400 and 320 lb. per sq. in. and for cetyl alcohol with steel test-pieces 205 lb. per sq. in. Inactive dihydroxystearic acid, prepared by oxidation of oleic acid, has doubled the joint strength of the stearic acid itself and its melting point is higher. The "pure" dyes, aurin and rosolic acid, were tested because triphenyl carbinol is an excellent adhesive for metal, and these two dyes are formed from the unstable, trihydroxy derivatives of triphenyl carbinol and tolyl diphenyl carbinol respectively. As expected they are good adhesives. The aurin had no sharp melting point and on strong heating gave an extremely viscous material. This appears to be of real significance, and it is probable that with such adhesives as aurin, pitch, sulphur, etc., the liquid heated to the maximum viscosity gives the optimum strength of joint. Such viscous molten adhesives are obviously capable of forming much stronger joints if sufficient pressure were used to make the films really thin instead of unusually thick. Nitrazole and cerasine yellow were somewhat weak, tannin orange and china green weak and thioflavine and azophor red so weak that they were easily broken by hand. Piperic acid, acenapthene and tribromophenol gave weak joints with aluminium. Qualitative observations were made with sodium palmitate (m.p. 316° C.) where the adhesive broke away from the nickel surfaces when fixing up the testing machine. Benzidine (m.p. 122° C.) and camphene (m.p. 48° C.) also gave weak joints.

The question of stability of various kinds of joints is important both theoretically and practically. It was found that ultimate strength of the joint is dependent on the rate of loading; this applies more particularly to joints set up with various recognised adhesives. Pure chemical substances seem to be superior to recognised adhesives in one respect, *viz.*, that joints made with the former are much less dependent upon time and previous heavy loading. Preliminary experiments with substances such as rosolic acid, malachite green and overheated glycollic acid between smooth nickel surfaces held 760 lb. per sq. in. for a month and did not then break until the load was increased to 2,200 lb. per sq. in. Rosolic acid with copper surfaces similarly showed no signs of failing in a week with a load two-thirds the final breaking strength. A joint with malachite green between copper surfaces held 700 lb. per sq. in. for a day before being broken at 870 lb. per sq. in. Stearic acid between nickel surfaces held 140 lb. per sq. in. for five minutes, being afterwards broken at 175 lb. per sq. in.

"Recognised Adhesives"

Gums, resins and waxes are of great importance in the lacquer industry, and a better understanding of the nature of adhesion of lacquer enamels to various materials has long been an urgent necessity. It is of interest to note that in general the degree of adherence of such enamels to metal falls in line, at least qualitatively, with the relation discovered between the joint strength and the mechanical properties of the materials united.

Fusible phenol formaldehyde resin and shellac in equal admixture between cast iron surfaces gave a much lower value for tensile strength, elasticity and internal pressure than that for each adhesive separately. Thicker films, as usual, gave still lower results. The low result with nickel and phenol formaldehyde resin and also coumarone resin is ascribed to the corrosion which occurred. Marine glue tended to segregate and became more brittle after long storage. Pitch may be recommended as a suitable and inexpensive ingredient for various adhesive compositions. The strength of the joints is much the same in tension, and in shear. In general the joints are much stronger when thin films are used between optically polished surfaces. The increase in strength in such cases seems to depend on the nature of the adhesive. The strongest adhesives furnish appreciably stronger joints, but with many weak adhesives such as Japan wax, the joint strength is doubled when optically polished surfaces are substituted for good plane metal surfaces.

The rule "the thinner the film the stronger the joint" summarises the results of many hundreds of experiments made with specific joints, using various adhesives and materials. Indeed, it appears to be universal experience that the strongest joints result when the glue films are the thinnest possible, provided always that the film is complete and entirely fills the space between the materials united; herein lies the art of perfect glueing. In some cases, however, more particularly when the adhesive is contained in a solvent and where a single coating leads to an incomplete film, a double or even triple coating may be applied to ensure that the above conditions are fulfilled. The fact that the joint strength increases very rapidly with film thinness, using shellac (applied molten), or pure trinitrotoluene (molten) between metal surfaces, is of deep significance for the theory of adhesion. Changes in the humidity of the atmosphere may cause profond changes in the mechanical properties of films of adhesives. For example, high-grade gelatine glue is strong in tension but exceedingly brittle in dry atmospheres, whereas in very damp atmospheres it will flow almost like a liquid under appropriate loads. It is the prevailing humidity which determines whether a film of gum arabic will not shatter. Humidity must likewise be a factor determining the strength of a glued wood joint, although complications are introduced by the colloidal nature of the wood itself.

General Conclusions of the Report

To summarise the contents of this final report it may be stated that pure chemical compounds of different types exhibit very different adhesive power when used for joining plane polished metal surfaces, the strength varying in definite relation to chemical constitution; the highest adhesive power for a pure chemical substance was of the order 1 ton per sq. in. Pure liquids between optically polished metal, glass or quartz surfaces give results of a lower order of magnitude, even when they are only a few millionths of an inch thick.

There is a notable increase of strength when the film of adhesive is made exceedingly thin, a phenomenon which is ascribed to chains of oriented molecules extending from the surfaces well into the liquid or solidified adhesive. In general, true adhesion phenomena in specific joints (both for liquid and solid adhesives) indicate that the effective range of molecular attraction may be hundreds of molecular diameters, the chain effect simulating a large direct range of attraction. The narrower form of Langmuir's theory and likewise that of molecular films on water may tend to be misleading when applied to adhesion phenomena in joints glued with pure chemical substances, and constitute only one particular case of adhesion. There is also direct parallelism between the strength of specific joints and the mechanical properties of the materials joined. Joint strengths rise with tensile strength and elasticity and fall with atomic volume and compressibility. Good lubricants are, as a class, poor adhesives; joint strength is often much the same whether tested in tension or in shear. Joints between sandblasted metal surfaces made with the same shellac adhesive are weaker th greater the pressure employed in sandblasting. The brittleness of an adhesive film may be greatly increased or entirely eliminated by appropriate additions.

Typical and significant data are presented for the adhesive power of various recognised adhesives and of pure substances for metals, as well as for the mechanical properties of a number of adhesives with added substances. Many new solvents and swelling agents for organophilic adhesives have also been found. It is noteworthy that a hydrophilic and organic colloid may be incorporated to form one homogeneous glue sol. Cellulose acetate dissolved in pyridine and added to acetate acid solutions of high-grade gelatine glue could be concentrated to a homogeneous viscous sol on boiling.

The investigations on gelatine, which form Appendix II of the "Third and Final Report of the Adhesives Research Committee," will be dealt with in a subsequent issue of THE CHEMICAL AGE.

Empire Chemicals for the United States

A Dwindling Market

THE United States draws from the four corners of the British Empire such large quantities of its chemical requirements as to make the Empire the most important single factor in its chemical import trade. According to a recent issue of "Commerce Reports," this trade reached the high-water mark in 1929 at nearly £10,000,000, from which the disturbed economic conditions of 1930 and 1931 have led to a sharp decrease. Imports from the British Empire to a large extent consist of commodities essential to the domestic chemical industry. This recognition is perhaps most clearly evidenced by the fact that, in 1927, about 81 per cent. of the total imports from the Empire entered the United States free of duty, and even in 1931 this figure was 79 per cent. of the total. Gums, resins, and balsams comprise a major factor, followed by crude drugs and essential oils, all of which are the principal export commodities of British Empire countries in the Far East. The United Kingdom's chief item (creosote oil) and Canada's leading chemical products shipped to the United States (calcium cyanamide and sodium cyanide) are other non-dutiable imports.

At the turn of the century the British Empire accounted for over 30 per cent. of the total chemical importations; in 1913 it dropped to 22 per cent.; but again increased in 1922, the first post-war year of business revival, to 29 per cent. Stiffening of inter-commodity competition, intensification of international trade rivalry, and the substitution of products of United States origin—in some cases the synthetic for the natural—for formerly imported articles, caused the relative importance of the imports from the British Empire to decrease slightly to 23 per cent. in 1927 to 22 per cent. in 1929, and 15 per cent. in 1931.

Heavy Declines Recorded

During recent years Canada has assumed the leading position as supplier, followed by the United Kingdom, and then British India. The growing importance of Canada in the United States import trade has been correlative with the development of water power to produce electro-chemicals. Imports from Canada, as from most other countries of the British Empire, dropped more than 50 per cent., but there is little change in the character of the products. During 1931, Canada supplied fertiliser valued at £490,000, consisting almost entirely of calcium cyanamide, and industrial chemicals, of which sodium cyanide to a total value of £170,000 was an important item, despite its decrease from £400,000 in 1929. Imports of acetic acid in the past have consisted largely of the synthetic product from Canada, but this item also registered a decline from £400,000 in 1929 to £300,000 in 1930 and only £160,000 in 1931. Formerly the almost exclusive source of cobalt oxide, Canada still shares with Belgium as a source of supply.

United States imports of chemicals from the United Kingdom have fluctuated widely in recent years, with a peak of £4,200,000 in 1923 and only £800,000 in 1931. The trade revolves chiefly around creosote oil and other coal-tar crudes, and the United Kingdom ships to the United States 90 per cent. of its exports of creosote. Increased domestic output and foreign competition, however, have aided in reducing imports of British creosote from £1,800,000 in 1924 to £250,000 in 1931. The decline in chemical import trade with the United Kingdom is also accounted for by its dissappearance as a source of ammonium sulphate, decreased shipments of glycerine, and loss of importance as a distribution centre for gums, resins and similar products from the Colonies. It still supplies most of the bleaching powder import requirement, some fertiliser and fair amounts of glue. Canada, the United Kingdom and British India contribute approximately 85 per cent. of all chemical imports of British origin.

Crude Natural Products from the Far East

Crude natural products have always kept India in an important position as regards imports into the United States. Its leading commodities, however, have also shown drastic decreases, chief among which is shellac, droppping from almost £2,400,000 in 1929 to £360,000 in 1931. Lac gum also figured in the 1931 imports to the extent of £197,000, while crude drugs accounted for almost £120,000. Gum kadaya, gum tragacanth, and other varnish, food and medicinal gums, and fair amounts of essential oils form the major portion of the remaining imports. Some of these products formerly were shipped to the United States by way of Great Britain, but this trans-shipment trade has lost its old importance. Hong Kong, a point of trans-shipment for many commodities from various countries, shipped in 1931 mainly tung oil, probably of Chinese origin, miscellaneous crude drugs, and a small amount of medicinals. British Malaya and Ceylon, with productive conditions similar to British India, parallel many of its shipments on a smaller scale. British Malayan trade, however, features gum damar as the principal item, with its crude drugs and small amounts of gums and resins other than damar accounting for the remainder of its greatly decreased trade. Ceylon is famed mostly for its distillation of citronella oil, and ships this with other essential oils and some crude drugs to the United States.

Essential oils, chiefly orange, lemon and lime account for the bulk of imports from the British West Indies, with Jamaica as the most important island in the group. Jamaican logwood, under present conditions, has been threatening to compete more severely with the Haitian logwood. Iraq's commodities are chiefly gum tragacanth and miscellaneous crude drugs totalling £22,000 and £38,000, respectively, in 1931. New Zealand trade has declined in proportion to its shipments of gum kauri, an indigenous product not available in commercial quantities in any other part of the world. Australia figures to a small extent in imports of essential oil. British Africa likewise participates with small quantities of essential oils, dye extracts, fertiliser materials and beeswax.

Gas Firing in the Pottery Trade

Some Economic Advantages

FIRING systems are being investigated very seriously in the five towns, which are the centre of the British pottery industry. For example, the substitution of a gas-fired regenerative oven in place of a coal-fired one for firing electrical porcelain goods has reduced firing costs from 7½ per cent. to 5 per cent. of the selling price of the article, reduced the time taken in completing small orders from 14 to 3 days, reduced the "rejects" by 50 per cent. and reduced furnace maintenance charges to a negligible sum. It has also made possible the baking of the "biscuit" and the firing of the glaze in one stage instead of two stages. These are a few of many advantages which have resulted from the installation during the last few years of a number of towns-gas-fired ovens in place of coal ovens in Stoke-on-Trent. Full particulars of these developments are contained in the current issue (No. 221) of "A Thousand and One Uses for Gas," which can be obtained free on application to the General Secretary, The British Commercial Gas Association, 28 Grosvenor Gardens, London, S.W.1.

Sulphur in Coal

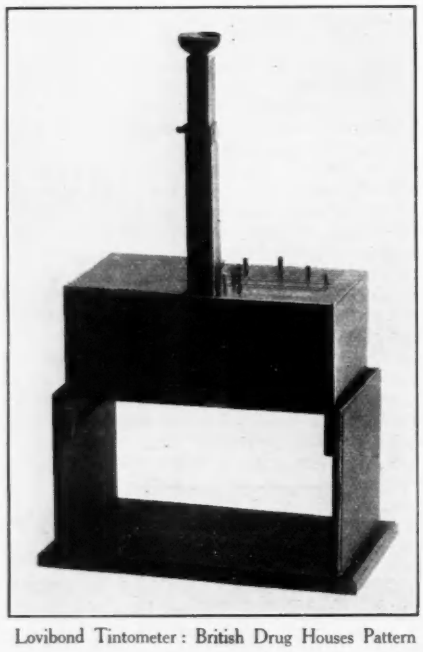
Removal Prior to Utilisation

SULPHUR dioxide, which is unavoidably formed in the burning of coal, and which, escaping from industrial smoke stacks, causes heavy losses in corrosion of buildings, will be eliminated from the atmosphere if a method worked out by Dr. Robert D. Snow, of Illinois University, becomes industrially feasible. Dr. Snow, who has attacked the problem theoretically, states that the sulphur can be removed from the coal before it is burned. His method involves the processing of coal at the mines before it is shipped. The coal is first ground, and then treated with an acid solution of ferric sulphate; the treated coal is washed and heated in the presence of hydrogen, when the hydrogen removes the remaining sulphur in the form of hydrogen sulphide. It is suggested that part of the sulphur can be recovered for commercial use. Up to 93 per cent. of the sulphur originally present in coal can be removed by this process.

Works Equipment News

Modern Aids for the Chemical and Allied Trades

TINTOMETER, Ltd., of Salisbury, has recently placed upon the market a new form of the Lovibond tintometer, known as the British Drug Houses pattern. The original Lovibond tintometer has, for a number of years, met the needs of many workers in a vast variety of industries. It is frequently necessary to make colour determinations rapidly, and this is particularly the case in determining the content



Lovibond Tintometer: British Drug Houses Pattern

of vitamin A in cod liver oil by the antimony trichloride reaction, and it was for this purpose that the British Drug Houses devised an instrument upon the lines of this apparatus.

The apparatus is compact and portable, of good appearance and exceedingly simple to work, there are no loose parts to get broken or lost, any of the well-known Lovibond colour slides can be fitted into the apparatus and immediately a match is obtained the value of the slides effective in the instrument can be read directly from the indicator plate. This new tintometer is already installed in a number of leading laboratories in this country and is proving popular among chemists in various fields of research. Practically the whole of the apparatus is constructed of bakelite and it is a very useful instrument for laboratories where colour tests have to be made.

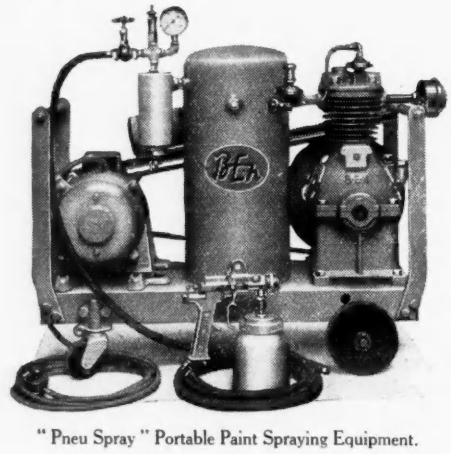
Pipe-lines for Acids

THERE can be nothing more disappointing in a chemical installation than continued loss and leakage from corrosion in pipe-line installations. The cost of replacement, stoppages and refitting of new lengths of pipe where corrosion is continually taking place involves considerable expense as well as delay. Any slight extra cost involved in the use of a metal which obviates these troubles may be ignored in view of the permanence of the job and the economies afterwards effected as a result of reliable pipe-lines. Among the more modern methods of lay-out of chemical plant, "Ironac" acid resisting iron, the product of Haughton's Patent Metallic Packing Co., Ltd., is becoming increasingly in demand for pipelines for acid. "Ironac" is a peculiar brand of high silicon iron which gives perfect resistance against the action of sulphuric acid or nitric acid either hot or cold, dilute or concentrated.

For many years the makers have been providing large vessels for both nitric and sulphuric acids made of "Ironac," and the development of acid pipe-lines constructed in this metal is becoming more and more standardised. "Ironac" pipes, bends, elbows, tees and special connections are made either with flanged ends or spigot and socket connections, but still more extensively such acid pipe lines are now being supplied in butt joints connected with loose cast-iron flanges. Some large orders are now in course of manufacture for these acid pipe-lines for refinery work and the explosives trades and some important installations of these butt-jointed type of pipe-line constructed of "Ironac" have been installed in some of the large synthetic nitrogen factories. Pumps of various types made of "Ironac" have long been on the market, and the installation of pipelines in connection with pumping schemes forms one of the more recent special studies of the company.

Spray-Paint Plant

MANY manufacturers are unaware of the great improvements which have been made in spray-paint plant. Although many factories have been using mechanical painting plants, especially those engaged on the mass production of articles, it is only recently that spray-painting has been recognised as the most economical method of redecorating the interior and exterior of factories. The chief advantage of spray-painting is the speed with which paint can be applied, and this is particularly noticeable where the painting of large buildings is necessary. The finish obtained by a spray gun compares more than favourably with that of brush work, the sprayed surface being more even and uniform, and it is found that one coat of paint sprayed is equal to at least two coats applied by the brush. The spray will blow the paint to places where it would be difficult for the brush to reach, and thus prevents rust or decay from taking place in parts that would otherwise be uncovered. For the purpose of illustrating the speed of spray-painting over the brush method, two awnings in a railway station with a total area of 750 sq. yds. required 198 hours to be brush painted. As against this, with the assistance of a labourer to move scaffolding and strain paint, the same area was covered by the spray in 23 hours.

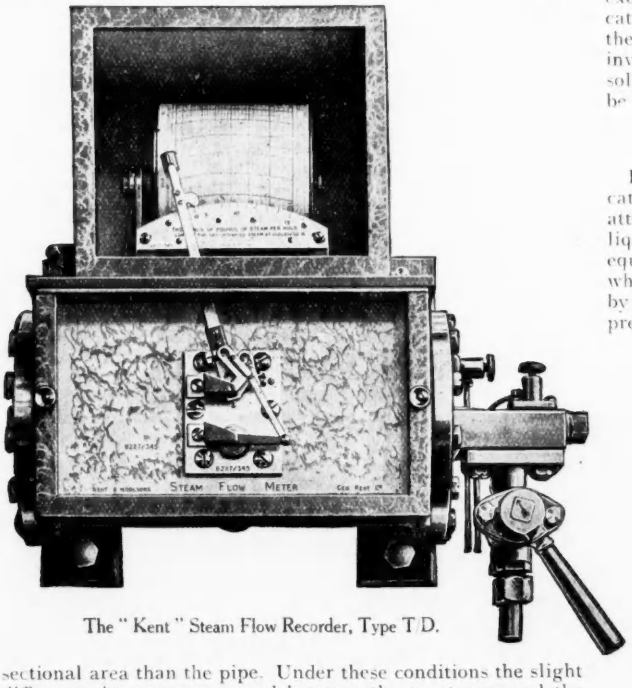


"Pneu Spray" Portable Paint Spraying Equipment.

B.E.N. Patents, Ltd., manufacture a range of fixed and portable spray painting plant. One of the most popular models is the B.E.N. "Pneu Spray," which is a portable outfit, mounted on rubber-tyred castor steering wheels, and equipped with a ¾ h.p. motor, or with petrol engine where electric current is not available. This plant is very simple to operate and is designed for heavy duty continuous work. B.E.N. Patents, Ltd., issue an up-to-date catalogue of their complete range of spray equipment including exhaust fans, respirators, spray booths, etc., a copy of which they would be very pleased to forward to anyone interested.

The Metering of Steam

FOR the efficient running of a chemical works or any other industrial establishment, it is necessary to keep a detailed record of the steam consumption of different departments or processes by means of meters. In this connection it is interesting to examine the latest designs in steam meters as made by George Kent, Ltd., Luton. These meters are claimed to be very accurate, suitable for any size of steam main, and are supplied in four varieties, of which one pattern gives a continuous record by means of a pen on a chart, while another pattern has both a chart and an integrator or counter, with a series of dials. For chemical works, with fluctuations in the demand for steam, there are meters of the chart only and chart-integrator pattern, including an automatic pressure correcting device, so that the records are absolutely accurate irrespective of the variation in the steam flow. All these meters operate on the orifice principle, a fitting being inserted in the steam pipe, the orifice being of somewhat less cross



The "Kent" Steam Flow Recorder, Type T.D.

sectional area than the pipe. Under these conditions the slight difference in pressure caused between the up-stream and the down-stream side of the orifice plate is proportional, under conditions of correct design, to the square of the amount of steam passing. This pressure difference is measured by means of a series of spring loaded metal diaphragms, the higher (up-stream) pressure being taken to the exterior of the diaphragms, and the lower (down-stream) side to the interior, the pressure variation being recorded directly, by both the chart and the integrating device, as lbs. of steam passing per hour and total number of pounds respectively. Various standard orifice fittings are used according to the conditions, a typical pattern consisting of a circular steel carrier or frame, $1\frac{3}{8}$ in. thick, fixed between the flange and steam pipe. This carries a monel metal orifice plate of either the circular or "chord" type and contained in the carrier are two pressure holes which lead to two short vertical cooling chambers filled with condensed water alongside the steam pipe. One of these holes connects to the up-stream side of the orifice and the other to the down-stream side, and both are coupled by narrow bore copper pipes to the recording portion of the meter, situated in any convenient adjoining position, the pressure difference being transmitted through condensed water with which the whole circuit is filled.

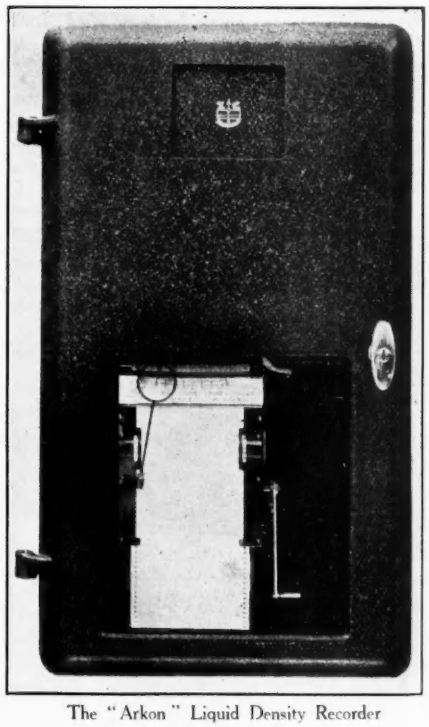
Contact Rings in Chemical Plant

THE Lessing contact ring, which has been marketed for many years by the Hydronyl Syndicate, Ltd., in a variety of sizes and materials, to suit all operations from laboratory work to large-scale commercial practice, is now being made available for all processes which by their nature preclude the use of metal rings. Lessing rings as now supplied in porcelain or stoneware will place at the disposal of engineers and chemists the advantages of maximum contact surface with minimum of space occupied, absence of channelling or back-pressure, and considerable economies in the sizes of units required to deal with a stated volume of material treated. For distillation purposes, these rings give a sharper cut than has been considered possible by any other means, and they possess the additional advantage that they operate equally well at any temperature, from the fractionation of liquid air to the separation of carbolic acid and cresols from crude tar acids.

These rings are also extensively used for scrubbing, washing and drying gas; for packing absorption towers, dust separators, vapourisers for enriching coal gas or introducing naphthalene solvents, oil separators for steam plants and for increasing the efficiency of condensers, coolers, heat exchangers and humidifiers. This extensive field of application is now being made even wider by the introduction of the stoneware and porcelain rings, and now covers processes involving the use or manufacture of corrosive acids, caustic solutions, food preparations or other materials which must be kept out of contact with metals.

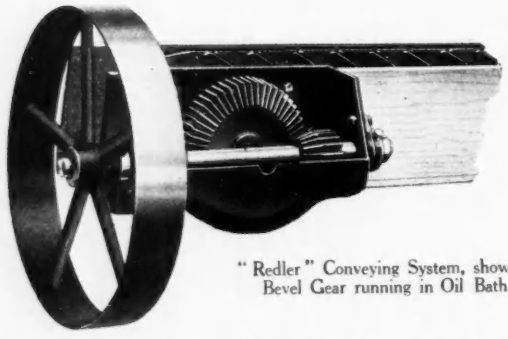
A New Liquid Density Recorder

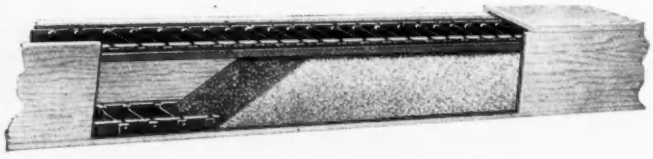
IN nearly all chemical works there is a wide field of application for a simple reliable density recorder requiring little attention and connected direct with the flow of the particular liquid being measured. Pulps, solvents, fats or oils are equally suitable for the new "Arkon" instrument illustrated, whether cold or warm. This instrument, which is supplied by Walker, Crossweller and Co., Ltd., is well in line with the present trend towards simplification. The chart, which can



The "Arkon" Liquid Density Recorder

be seen through the inspection window, is of the unwinding roll type, having an effective width of 100 mm. and a travel of 20 mm. per hour. The density can be recorded in any desired graduations, e.g., Baumé, Brix or Balling degrees, or simply as specific gravity. The accuracy is guaranteed to ±1 per cent. of the range, which is optional within wide limits. The instrument has a pressure range of vacuum to 1 atm. pressure, and higher if specified. The casing is made of metal while the door is cast from a special



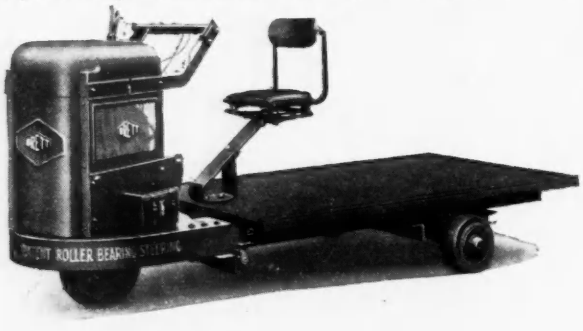


"Redler" Conveying System, showing Bevel Gear running in Oil Bath.

light metal, and is suitable for flush type panel insertion or simple wall attachment. The vessels are made of strong special glass and will resist temperatures from 0 to 100°. For the connection tubing, brass, copper, nickel, steel or other special tubing is used, according to the kind of liquid being measured. If the liquid is dirty, a special filter is inserted in front of the instrument. All parts are easily accessible and interchangeable. The liquid flows in a closed circuit through a measurement vessel which forms part of an inclination balance. The inclination weight is not, however, of fixed weight, but is equal to the constant volume of a standard liquid, the weight of which change in accordance with temperature variations to the same extent as the liquid under test. As a result of this the temperature influence is completely offset, the method being entirely automatic and continuous, and depending not on any delicate mechanical means but on purely physical phenomena.

Petrol-Driven Industrial Trucks

THE "Brett" truck, which is made by Bretts Patent Lifter Co., Ltd., has several interesting features. It will turn in its own length, its lubricated roller bearings ensure easy steering, and the framework is constructed to give perfect steadiness under heavy loads It is extremely economical in running costs, one gallon of petrol being sufficient to propel the vehicle for a complete day of eight hours, during which time many tons of material can be handled and many miles covered around difficult corners and under conjested conditions. Several standard types are made—a low loader truck for service where convenience in loading is desired; a high level platform truck with large wheels, suitable for



The "Brett" Petrol-Driven Truck: Low Loading Type.

heavy loads and for travelling long distances; a low loader equipped with hydraulic elevating table, which can be fully elevated in ten seconds; a low loader fitted with low adaptable sides, and a high level platform truck with high detachable sides. All of these models can be fitted with reversing gear, by means of which the truck can be propelled backwards or forwards as required. The arrangement of drive is a very simple one and consists of two large bevel gears with sprocket wheel working between: a single movement of a sliding dog gives forward or reverse motion. Reversing gear is, of course, a very useful addition to trucks, especially those fitted with elevating type platform for use with stillages. The nominal capacity of these trucks is 30 cwt., and the speed is 10 miles per hour.

Conveying Systems

REDLER conveying systems are well-known in over fifty different industries. The conveying members in every machine manufactured are of open linkwork construction. The principle involved is identical in every type of machine, *i.e.*, an "en masse" load is conveyed, whether horizontally, inclined or vertical. The accompanying illustration shows a standard Redler "en masse" conveyor with part of the box removed and the "en masse" load moving, as well as the driving terminals with S.K.F. ball bearings and its bevel reducing gear running in an oil bath. The load conveyed by this type of Redler is equal in height to the width of chain: thus if a 7 in. chain is used the load would be 7 in. in height, the load being moved with and at the same speed as the chain. Feeding of the machine can be either through the top run of chain or on the sides, whilst discharge outlets can be fitted as and where required in the bottom of the conveyor.

Chains for standard Redlers are supplied in various widths and types dependent upon the material being handled and capacity required per hour. The method of assembly also depends upon the characteristics of the material. All chains are easily detached. Redler conveyors are totally enclosed, dustless, and self-cleaning, and owing to the slow speed and bulk loads, the material is handled gently and without breakage. The material clings together and forms a solid ribbon which is not subjected to friction against the sides of the box as the material and chain move together from the feeding point to the discharge outlet. A further development in the method of lubrication has recently been decided upon, and in future this will be by Tecalemit force-feed lubrication.

Chemical Asphalt

THE uses of chemical asphalt, Acetas brand, can be roughly divided into two groups, the first for floors and the second for the lining of tanks, the four grades being Acetas and Acetas H, HHS and HH. Acetas acid resisting tanking asphalt is employed as a lining for tanks, ducts, etc., where temperatures do not exceed 80° F. This will withstand solutions of inorganic acids of the following approximate strength: Hydrochloric acid 1.10 sp. gr.; sulphuric acid 1.40 sp. gr.; and nitric acid 1.31 sp. gr. It is unaffected by acetic acid of all concentrations. Under some circumstances the acid strength can be increased, but the temperature may be regarded as the maximum, as above this the asphalt is inclined to soften and distort, and as a general rule an increase in temperature lowers the resistance of the asphalt.

Acetas H acid resisting flooring asphalt is used exclusively for flooring under moderate conditions. The same limits apply to this specification as those given above, but these depend to a large extent on the traffic conditions and to a lesser degree on facilities for washing or flushing down the floors.

Acetas HHS special acid resisting tanking asphalt is employed as a tank lining, etc., where high temperatures and strong solutions prevail. The maximum temperature so far employed on a practical scale is 150° F. to 170° F. but under experimental conditions it has stood up to 200° F. At lower temperatures the resistance to acid action is greater and it has been found that this grade will resist acids of commercial strength, but in most cases it is necessary to balance temperature conditions with the solutions employed. A typical instance is a tank recently lined carrying solutions at 170° F. and containing the following: Iron 31.5 g. per litre; copper 8.4 g. per litre; and sulphuric acid 42.6 g. per litre, with sometimes hydrochloric acid and chlorides.

Acetas HH special acid resisting flooring is a material the specification of which is based on similar lines. It is, however, somewhat harder, and designed for use where strong solutions are encountered and high temperatures and heavy

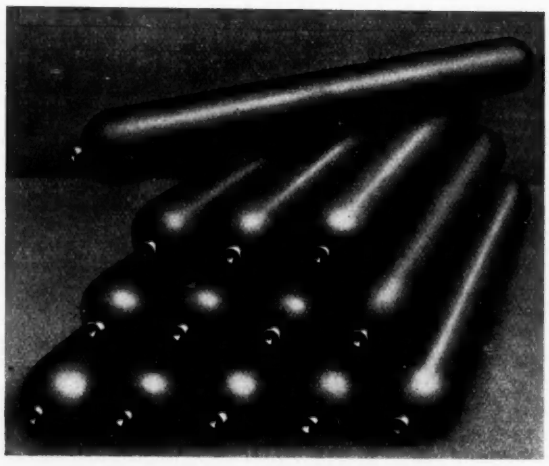
trucking conditions prevail. The acid resisting qualities are similar to those of the foregoing tanking material, the only difference being that this specification is designed exclusively for flooring. Chemical asphalts should not be employed in connection with the petroleum or coal tar distillates and by-products, organic solvents and vegetable oils. Certain other acids such as chromic acid, etc., cannot be successfully dealt with in solutions of any strength, but Acetas asphalt is not affected by alkaline solutions of any strength.

Floors are, perhaps, the best known and wides used application of mastic asphalt in chemical works. Asphalt provides a jointless homogenous covering which, if properly laid and treated, will remain liquor-proof for years, even in the presence of corrosive substances. The material differs from that employed in tank work in that it has to carry weights and is therefore suitably reinforced. Acetas asphalt floors resist corrosion admirably, particularly if their surfaces are looked after by being frequently washed down. The mixtures used are normally rich in bitumen and relatively low in mineral filler, weight resistance being more or less secondary to corrosion resistance, the filler present being only sufficient to stabilise the product and to obviate distortion at the temperatures to which it will be exposed.

Motive Power for Transport

INTEREST is being displayed in the proposed use of town's gas for transport purposes, and experimental work of this nature has been taking place at Chesterfield for some time. One of the difficulties has been the storage of the gas under high pressure, the present regulations permitting coal gas to be transported under a maximum pressure of 120 atmospheres, or approximately 1,800 lb. per sq. in. The pressure now suggested for the storage of the gas in steel cylinders or containers is 200 atmospheres, or 3,000 lb. per sq. in., although cylinders for even higher pressures can be made. Such conditions demand the provision of special gas containers. The special cylinders made for this purpose by the Chesterfield Tube Co., Ltd., were referred to in the 1919 report of the Inter-Departmental Committee on the Employment of Gas as a Source of Power.

Since then there has been a great improvement in the manufacture of alloy steels. The cylinders now being made have

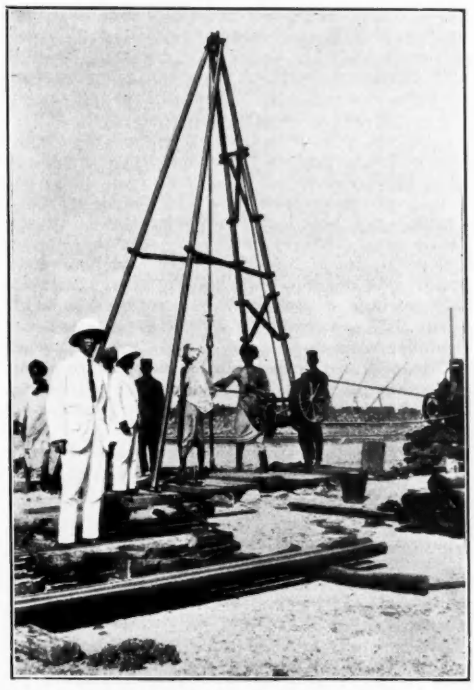


Special Cylinders of Alloy Steel for storage of Town's Gas when used as motive power (Chesterfield Tube Co., Ltd.).

an outside diameter of approximately 8 in. and an overall length of 6 ft. The corresponding gas capacity will be approximately 350 cu. ft., which equals about 1½ gal. of petrol, and it is suggested that six or eight cylinders are sufficient for an ordinary commercial vehicle and a mileage of 60/80 miles.

Well Drilling Equipment

AN important asset to modern industry is the ability to draw upon unlimited supplies of water at economical figures. Supplies running into hundreds of millions are needed annually by almost every branch of industry. Part of this is drawn from underground sources by means of deep boreholes and artesian wells. LeGrand, Sutcliff and Gell, Ltd have been engaged in drilling deep wells and installing pumping units in various parts of the country since 1870. Many notable wells have been drilled in London. During the last ten years nearly two hundred deep boreholes have been put down into the chalk in the London area. This company



Trial Boring Work for the Bombay Port Trust: the drilling plant and supervision were supplied by Le Grand, Sutcliffe and Gell, Ltd.

maintains a staff of experts capable of dealing with the problems which present themselves in such specialised work as well drilling, and from their past experience and large accumulation of records and data, are well equipped to deal with any problems connected with underground water supplies.

The company is the possessor of a patent drilling rig capable of drilling at considerable speeds—sometimes as much as 150 ft. have been drilled in a suitable formation, in a 10-hour shift. The work of this company is not confined to England; its rigs and men have carried out some interesting work in several of the colonies and the illustration depicts drilling work in progress for the Bombay Port Trust. One of the company's specialities is the Abyssinian tube well, which takes its title from the country of that name, in which it was first used in the Abyssinian wars. Excellent supplies of water were obtained for the troops, and these tube wells are still being exported to the colonies and other places abroad. Tube wells are easily driven, and if large supplies are needed several may be driven at adjacent sites, and connected to a common main, from which water may be fed to required points.

German Consumption of Casein

GERMANY consumes 15,000 metric tons of casein out of a total estimated world production of 60,000 tons. The bulk of the demand is supplied by imports, with the plywood, paper, plastics and paints industries as the chief consumers. In 1931 German imports of casein and of animal albumen glue, amounted to 15,760 metric tons, of which France and Argentina supplied 13,600 tons or 86 per cent. Imports in this classification are believed to be almost entirely casein, since blood albumen demand has been ascertained to be small.

Uncreasable Cotton Fabrics

A New Application for Synthetic Resins

THE textile industry has waited many years for cotton fabrics which have the uncreasable properties of wool and silk and has therefore warmly welcomed the recent announcement of Tootal, Broadhurst, Lee and Co., Ltd. (THE CHEMICAL AGE, August 13, 1932, page 148), that they have perfected methods for making cotton and other cellulosic materials, including viscose rayon, definitely resistant to creasing.

At the moment it is impossible to state exactly which particular substances will be used in the treatment. It is very possible, however, that they will be of the synthetic resin type outlined in the various patents (Brit. Pat. 291,273, 291,274 and 304,900, with their amendment) taken out by Tootal, Broadhurst, Lee and Co., for protecting the methods which they have discovered. The essence of these patents is that cotton and other fibres may be made uncreasable by incorporating in them comparatively small quantities of synthetic resins, it being most important that the resin be deposited within each individual fibre and not outside as a coating film. If the fibres are merely coated with the resin they stick together, become stiff, and are then *more* creasable than before. The patents refer mainly to synthetic resins formed from formaldehyde and such substances as urea and phenol: the resins may be formed within the cotton fibres or they may be applied as such from a suitable solution. In the latter case a final heating process is almost always necessary to convert the resin into a form having maximum insolubility.

Two Practical Formulæ

Cotton fabric, for instance, is padded with a liquor consisting of 20 parts of 40 per cent. formaldehyde, 10 parts of urea, 5 parts of boric acid, and 60 parts of water, maintained at ordinary temperature and then dried at 130° C. for about half an hour. Under these conditions the urea and formaldehyde condense under the catalytic influence of the boric acid to form a resin within the cotton fibres. Afterwards, loosely adhering resin is removed by a boiling soap treatment. Alternatively, cotton fabric is mercerised in the usual manner and after washing out the alkali, but before drying, it is impregnated with a mixture of 100 parts of phenol, 100 parts of 40 per cent. formaldehyde, and 4 parts of potassium carbonate, which is boiled for 5 minutes and then rapidly cooled. The fabric is then stentered on a hot air stentering machine such that it is dried at a low temperature, being afterwards heated at 170° C. for two minutes and finally soaped.

A catalyst is generally required in the formation of formaldehyde synthetic resins and this may be acidic or alkaline. In the case of cotton, tendering occurs when this fibre is heated with an acid so that it is preferable to use an alkaline catalyst as indicated in the second example described above. It is known, however, that formaldehyde resins are liable to become coloured when treated with alkalis, so that great care must be exercised in choosing the resin to be applied to white cotton materials. Presumably a colourless resin has been discovered for this purpose. Examination of fabric made uncreasable by the new process indicates that a formaldehyde resin is being utilised. Synthetic resins, too, are liable to harden during prolonged exposure to light or storage, and this point will require attention, since it would be fatal to the success of the new process if the uncreasable fabrics so produced gradually lost this property.

It is believed that uncreasable cotton and viscose rayon will find a very wide application in the production of dress materials. In rayon crêpe fabrics the uncreasable treatment will not be so important, since these fabrics already largely resist creasing owing to the twist in the yarns from which they are made.

Chlorinated Solvents in France

MOST of the chlorinated solvents are manufactured in France, principally by the Société Industrielle de Produits Chimiques Bozel-Maletra. The Cie. de Produits Chimiques et Electrometallurgiques Alais, Froges et Camargues, and "Progil" produce small quantities of trichlorethylene and tetrachlorethane. This production is said to satisfy most of the domestic demand for chlorinated solvents except for some trichloroethylene and dichlormethane, the latter not being produced.

European Nitrate Agreement

Statement by I.C.I.

THE new arrangement between the nitrate-producing countries of Europe is generally considered in Berlin to be a good step forward, compared with the agreement laid down in the "Convention de l'Industrie de l'Azote" of 1930. While no details are available, it is understood that the arrangement between the European countries extends over several years. The control of European exports will in future be centralised in a board on which Great Britain, Germany and Norway are represented, and which will control the industries of Great Britain, Germany, Norway, France, Holland, Belgium, Poland, Italy, Czechoslovakia and Switzerland. The home markets, with the exception of the northern countries and Spain, will be reserved solely for their respective industries, which will also regulate the home market prices. A restriction of production was not agreed upon, but will regulate itself in accordance with the home demand and the export quota.

An understanding with Chile is greatly handicapped by the enormous stores of nitrate (amounting to 430,000 tons in terms of nitrogen or 2,800,000 tons of nitrate of soda) ready for shipment. Chile, at present, is rather obstinate, and is trying to intimidate the European producers with the threat of dumping in all markets. This threat, however, has not been taken seriously, especially as the banks, which have to finance the Chilean exports are opposed to it, and demand a period of at least two years for the sale of the Chilean stores of nitrate. The main obstacle, however, is the export quota to be allotted to Chile, and this quota is the subject of negotiations between Europe and Chile. No agreement could be reached at Scheveningen, and nothing can be said for the present as to where the final negotiations will take place.

In view of the fact that the reports emanating from Berlin regarding the international nitrate conference are open to misinterpretation, Imperial Chemical Industries, Ltd., states that "The Scheveningen negotiations settle the basis of agreement between the European Convention and the Chilean interests. Completion of the agreements awaits ratification by the separate groups comprising the European Convention and by Chile, and also the completion of certain outstanding negotiations which the parties feel confident will find their satisfactory solution."

Estimation of Molybdenum

Use of α-Benzoinoxime

PRESENT procedures used for the estimation of molybdenum, except the colorimetric method which is applicable to only small amounts, require a number of tedious and time-consuming operations before the actual estimation of that element can be accomplished. At the United States Bureau of Standards, however, it has been found that when α-benzoinoxime, a reagent originally proposed for the estimation of copper, is added to cold sulphuric, hydrochloric or nitric acid solution of sexivalent molybdenum, not only is molybdenum quantitatively precipitated but it is readily separated from a large number of other elements such as copper, lead, bismuth, tin, arsenic, antimony, iron, titanium, chromium, vanadium and many others. Tungsten and palladium, which are also quantitatively precipitated by the reagent, should be removed, if present, before attempting the precipitation of molybdenum. The interference of silicon and tantalum is of no great importance and can easily be avoided. As applied to ores and similar material, precipitation with α-benzoinoxime is effected directly after removal of lead, silica, etc., by dehydrating with sulphuric acid. The resulting precipitate, after appropriate washing, is dried, ignited and weighed as molybdenum trioxide. The ignited oxide is dissolved in dilute ammonium hydroxide, acidified with hydrochloric acid and treated with cinchonine. Any resulting precipitate of tungsten is filtered, ignited, weighed and deducted from the weight of molybdic oxide already obtained. In the case of steel, precipitation is made directly after solution and oxidation of the sample by means of sulphuric and nitric acids. The treatment of the precipitate is the same as that outlined for ores. Further details of this method are given in the July issue of the "Bureau of Standards Journal of Research."

Organic Catalytic Reactions

By JAMES A. MITCHELL

ONE of the most active fields in experimental chemistry is that of organic catalysts. In this article, reprinted from a recent issue of the "Journal of Chemical Education," a survey of methanol synthesis is presented as well as a consideration of the synthesis of higher alcohols from carbon monoxide and hydrogen, the high-pressure hydrogenation of coal and petroleum, and the vapour phase oxidation of benzene to maleic anhydride, of naphthalene to phthalic anhydride, and of anthracene to anthraquinone. The author, who was originally at the John Hopkins University, Baltimore, is now associated with the du Pont Cellophane Co., of Buffalo, New York.

OFTEN a new material is added to the list of active hydrogenation catalysts. Thus within fairly recent years Brown and Henke (1) have indicated that tin is an active catalyst for the hydrogenation of nitro-benzene, peculiarly enough at a temperature above its melting point. Williams (2), however, has shown that this catalyst is probably covered with a surface film of oxide and that tin oxides are effective in the reduction of nitrobenzene, while molten tin is not. Interesting additions to the list of hydrogenation catalysts are the alkali metals. Guyot (3) has investigated the reduction of naphthalene in the presence of potassium and sodium. Naphthalene is readily hydrogenated to tetralin in the presence of sodium at 300° and 100 atmospheres of hydrogen pressure, provided the materials are dry. Potassium is a poor catalyst, but sodium-potassium alloys are exceptionally active. These catalysts are insensitive to the usual poisons and, as the metals are molten at the hydrogenating temperature, vigorous agitation or the addition of magnesium oxide or infusorial earth is beneficial. Cusmano (4) has also studied the activity of alkali metals in hydrogenation. Hill and Kistiakowsky (5) have attempted to determine whether or not the mechanism of this reaction, with metallic cesium, involves intermediate compound formation of the hydride. It was found that the hydride really acts as a poison by covering the free metal surface. Only hydrogen adsorbed on the metal surface is concerned in the reaction. Pease and Stewart (6) have shown that calcium hydride is much less effective than calcium in the hydrogenation of ethylene. Adkins and Connor (7) have found that copper chromite is an efficient hydrogenation catalyst except in reactions involving cyanides or the benzenoid nucleus. In contrast with nickel, this material is not readily poisoned by sulphur or halogen compounds. Zinc chromite is less active.

Escourrou (8) has been active in studying selective hydrogenation under reduced pressure. Under these conditions the activity of a catalyst is decreased, but the removal of the reduction products is facilitated. Under reduced pressure in the presence of platinum the double bond in certain unsaturated higher alcohols may be hydrogenated without affecting the alcohol group, but at atmospheric pressure saturated hydrocarbons are obtained.

The Methanol Synthesis

The syntheses of ammonia and methanol have been the first high-pressure catalytic reactions to be conducted on a commercial scale. The older method of obtaining methanol by the destructive distillation of wood is gradually being displaced by synthetic methanol obtained by the hydrogenation of carbon monoxide and it will not be long before this latter process will constitute the sole source. In the earliest efforts synthetic methanol was produced as a by-product in the ammonia synthesis ((9). Because of its commercial importance the methanol synthesis has been one of the most intensively studied organic catalytic reactions.

Carbon monoxide and hydrogen may react in any of the following ways :—

(1) $CO + 3H_2 = CH_4 + H_2O + 50{,}000$ cal.
(2) $2CO + 2H_2 = CH_4 + CO_2 + 60{,}000$ cal.
(3) $CO + H_2 = HCHO + 2{,}000$ cal.
(4) $CO + 2H_2 = CH_3OH + 25{,}000$ cal.

The free energy decrease involved in the production of methanol is less than in methane. Moreover, the methanol reaction involves the largest volume decrease. Thus not only must catalysts be used that are capable of selectively promoting the methanol reaction, but high pressures are necessary in order to shift the methanol equilibrium to the right and also to disfavour the methane reaction. The speed of the reaction is so slow at low temperatures that even with the best catalysts a temperature as high as 300° is necessary.

Patart (10) in 1924 reported that zinc oxide was an effective catalyst for the formation of methanol from carbon monoxide and hydrogen. He had observed that in the presence of this material methanol was decomposed into carbon monoxide and hydrogen and reasoned that it should also be effective in the reverse reaction. It was soon found that mixed or promoted catalysts were more effective. The original Patart process used catalysts consisting of copper and zinc oxide at temperatures of 400 to 420° and at pressures of 150 to 250 atmospheres. Later the use of chromates, manganates, molybdates, and tungstates was patented. It is also claimed that sub-oxides of vanadium, manganese, tungsten, lead, and bismuth are effective catalysts.

Methanol Catalysts

Audibert and Raineau (11) have made a comprehensive study of methanol catalysts. Oxides of aluminium, silicon, molybdenum, vanadium, tungsten, titanium, magnesium, calcium, strontoum, barium, and copper were found to be inactive. Active oxides were those of cerium, uranium, beryllium, zirconium, manganese, chromium, and zinc. Reduced copper and zinc oxide were the most effective catalysts studied. Iron, cobalt, nickel, platinum, and palladium, although they were effective in decomposing methanol, favoured side reactions in the synthesis, such as the formation of methane. Catalysts used at the present time are usually mixtures of zinc oxide, chromium oxide, and copper. Taylor and Kistiakowsky (12) have shown that a mixture of zinc and chromium oxides exhibits a greater adsorptive capacity for carbon monoxide and hydrogen than does zinc oxide alone. Their results indicated that carbon dioxide and water vapour act as poisons for the methanol synthesis. Contrary to this Smith and Hawk (13) and Plotnikov and Ivanov (14) have found that carbon dioxide does not act as a poison even though it is strongly adsorbed by the catalyst. Fenske and Frolich (15) have studied mixed catalysts of zinc oxide, chromium oxide, and copper. Such catalysts are not only more efficient, but less susceptible to poisoning. The copper is completely reduced, zinc is partially reduced, and chromium is reduced to the sub-oxide.

Huffman and Dodge (16) have shown that there is a parellelism between synthesis and decomposition over a series of zinc-chromium catalysts. Storch (17) states that the addition of chromium oxide to a zinc oxide catalyst increases the activity of the catalyst for the synthesis of methanol, but does not affect its activity in regard to decomposition. Frolich, Fenske, Perry, and Hurd (18) have shown that traces of sodium hydroxide or nitrate caused copper catalysts to lose their activity above the melting point of the occluded salts. These workers have also compared the properties of certain catalysts precipitated by ammonium and sodium hydroxides. The latter catalysts favour the production of methyl formate rather than formaldehyde in the decomposition of methanol. The presence of occluded alkali salts can account for the divergent results of workers in this field. Brown and Galloway (19) have compared the activity of zinc oxide, basic zinc chromate, and normal zinc chromate. The last two are the most active under conditions of high temperature and pressure, the normal chromate being the most active. Lewis and Frolich (20), because of the exorthermal nature of the reaction, found it beneficial to support the catalyst on a good heat conductor such as granulated copper to prevent local overheating. They observed, as previously notes by Rogers (21), that zinc oxide, ordinarily non-reducible, is partially reduced when in contact with copper.

Equilibrium of the Methanol Reaction

Quite naturally numerous efforts have been made to calculate and experimentally determine the equilibrium position of the methanol reaction. Kelley (22) published the first calculation using the best available thermo-dynamic data. Later Smith (23) and also Francis (24) repeated the calculation using different data, but obtaining essentially the same result. Re-

cently Kelley (25) has re-calculated the free energy and equilibrium constant of the reaction using better data. All calculations lead to values for the equilibrium constant which are far from agreement with the experimental results. The experimental results of the workers in the field, however, agree very well among themselves even though very different conditions were used (26).

Ghosh and Chakravarty (27) measured the equilibrium constants for the two reactions:—

$$CH_3OH = HCHO + H_2$$
$$HCHO = CO + H_2$$

and from this data were able to calculate a value for the equilibrium constant for the methanol reaction. The value of their work is questionable as the results disagree with all others—either calculated or experimental. Christiansen (28) studied the reactions:—

$$HCOOCH_3 + 2H_2 = 2CH_3OH$$
$$CH_3OH + CO = HCOOCH_3$$

and from these determined the methanol equilibrium constant. Recent work has shown that Christiansen's results are probably very near the truth, although at the time his results were not accepted as accurate, mainly because he himself was of the opinion that the experimental error might be very great. Brown and Galloway (29) and Audibert and Raineau (30) have stated that the Nernst approximation formula gives results in agreement with those obtained in high-pressure synthesis.

Smith and Branting (31) have recently made a direct determination of the equilibrium constant at atmospheric pressure which is in fair accord with other experimental results. Newitt, Byrne, and Strong (32) have also published data on the direct determination of the equilibrium constant at 100 atmospheres approaching equilibrium from both sides. Lacy, Dunning, and Storch (33) have re-determined the equilibrium constants for the reactions in which Christiansen was interested. Their results, although considerably more accurate, check well with Christiansen's. Wettberg and Dodge (34) are of the opinion that the results of the last two investigations mentioned are low because side reactions were not taken into account. Their results are slightly higher after taking care of this factor. According to Smith and Hirst (35), Roth has re-determined the heat of combustion of methanol and upon combining this with Kelley's specific heat data a value for the equilibrium constant is obtained which is in good agreement with Smith and Brantling's experimental value. Thermodynamic methods may be exact and rigorous, but one must remember that thermodynamic calculations are no better than the data on which they are founded. The use of the "best available data" is not necessarily indicative of accuracy—calculations are most reliable when they are verified experimentally.

There is no doubt but that formaldehyde is the primary product in the decomposition of methanol (36). It has been found (37) that with mixtures of zinc oxide and copper the most efficient catalysts are obtained when zinc oxide is present in excess. The catalyst most effective in the formation of carbon monoxide is the best catalyst for the synthesis. Zinc oxide promoted with copper favours the formation of carbon monoxide, while copper promoted with zinc oxide favours the formation of methyl formate.

Selectivity in Catalysts

Some interesting results have been obtained by an X-ray examination of copper-zinc oxide catalysts (38). Materials were examined varying in composition from 100 per cent. copper to 100 per cent. zinc oxide. Each constituent was present in the same crystalline form as that in which it ordinarily occured in the normal state. The size of the unit cell of the copper and zinc oxide lattice, however, was found to vary. The most important point in connection with these constituents is their selectivity in regard to the mechanism of methanol decomposition. As has been previously stated, copper selectivity favours the formation of methyl formate, whereas zinc oxide favours decomposition into carbon monoxide and hydrogen. It was demonstrated that a parallelism existed between variance in length of the unit copper cell and the percentage of methanol decomposed into methyl formate. A similar relationship existed between the size of the zinc oxide unit cell and the percentage of carbon monoxide produced. These facts point to an important relation between inter-atomic spacings in the catalyst and selective catalytic activity.

Catalysts of zinc and chromium oxides containing less than 50 per cent. zinc promote side reactions in the decomposition of methanol producing carbon dioxide and unsaturated hydrocarbons (39). Chromium oxide is an active water gas conversion catalyst and the formation of carbon dioxide can be accounted for on the basis of this reaction: $CO + H_2O = CO_2 + H_2$. Smith and Hawk (40) have found that catalysts of this type contain zinc and chromium in chemical combination, even after reduction, and that they exhibit properties of neither alone. With an excess of chromium oxide, the specific action of this catalyst becomes apparent.

Brown and Galloway (41) have determined the amount of dimethyl ether formed as a side reaction in the synthesis in order to determine whether or not this might explain the divergence between calculated and experimental results. Using normal zinc chromate only a small amount of the ether was formed. A copper-chromium oxide catalyst produced large quantities of dimethyl ether.

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(To be continued.)

United States Arsenic Production

Production of arsenic as arsenious oxide in the United States in 1931 amounted to 17,137 short tons, of which 14,482 tons were refined and 2,655 tons were crude. The entire output in 1931 was a by-product from smelting copper and lead ores. The products for the market consisted of refined white arsenic, crude white arsenic, "black" dust, and "treater" dust. A total of 13,777 tons of refined and crude arsenic was sold; it was valued at $799,744 (approximately £160,000 at par) or 2.99 cents per pound. The refined white arsenic (11,982 tons) was sold for 3.00 cents per pound; the crude arsenic (1,795 tons) was sold for 2.18 cents per pound.

Utilisation of Empire Raw Materials

Notes on Recent Progress

The following extracts are taken from the current issue of the "Bulletin of the Imperial Institute" (Vol. 30, No. 2), which periodically reviews progress in the utilisation of various raw materials from the Dominions, Colonies and India.

THE palm oil industry in Malaya has shown steady progress since planting on a commercial scale was started in 1917. Of the total area in 1930, 19,475 acres are recorded as mature, and 16,391 acres as immature. Areas considerably in excess of those already planted have been alienated by the Government for oil palm planting, and there is every prospect that the industry will continue to expand. Many of the estates have well-equipped factories for the production of palm oil and the separation of the kernels, and the number is increasing year by year, six new factories being opened in 1930. In general, the centrifugal type of extractor is favoured in Malaya, in contrast to Sumatra, where the press system is preferred. Opinion is still divided as to which system gives the better results and machinery has recently been installed at the Government Experimental Factory at Serdang with a view to comparing the two systems.

Palm oil and palm kernels have been shipped from Malaya since 1923, but exports were not shown in the official trade returns till 1927. Net exports for that year onwards have been as follows:—

Year.	Palm oil. Tons.	Palm kernels. Tons.
1927	786	175
1928	1,334	255
1929	1,831	263
1930	3,211	485

Malayan palm oil, like that from Sumatra, is of excellent quality and fit for edible purposes, the free fatty acid content being generally between 3 and 5 per cent., as compared with figures ranging from 8 to 80 per cent. in the case of West African palm oil, which, in general, is only suitable for soap-making and similar purposes. The market value in the United Kingdom of the Malayan oil varies from about 7s. 6d. to 27s. 6d. per ton above that ruling at any particular time for the West African product. The Malayan Government are fully alive to the importance of the industry and extensive research on the cultivation of the oil palm is being carried out by the department of Agriculture. Matters that are receiving particular attention are seed selection, the much-debated question whether artificial pollination is desirable, pruning the palm, manuring, pests and diseases, and investigations on the manufacturing side.

Bamboo for Paper Manufacture

In 1925 the India Tariff Board, as a result of representations made by Indian paper-makers, considered the question of granting protection to the industry with the objects of freeing it from dependence on foreign materials and of eventually developing an export trade in bamboo pulp.

The protective duties imposed on certain kinds of paper under the Bamboo Paper Industry (Protection) Act, 1925, expired on March 31, 1932, and the Tariff Board was requested by the Government of India to ascertain the extent to which the Act had achieved its purpose and to consider whether the continuance of protective measures was desirable. Inquiries were made accordingly and the results have been published in the "Report of the Indian Tariff Board on the Grant of Protection to the Paper and Paper Pulp Industries" (Calcutta, 1931).

There are now nine paper mills working in India, the total output of which in 1930-31 amounted to nearly 40,000 tons. A large increase in the use of imported wood pulp by the Indian mills has been attributed partly to the fact that the financial aid proposed by the Tariff Board for the development of bamboo was not granted and partly to the fall in the price of wood pulp. It has led to an annual expenditure of about Rs. 20 lakhs on Indian materials and labour which would otherwise have been spent on imported paper. The additional market for paper in India which the Indian mills may expect to capture is about 20,000 tons per annum, apart from any normal increase in consumption.

Bamboo is available in India and Burma in sufficient quantities not only to supply the entire Indian demand for pulp, but also to develop a large export trade. Air-dry bamboo which cost about Rs. 55 per ton in 1924-25 is now obtainable at Rs. 38-40 or even less. Considerable progress has been made regarding the mechanical treatment of the bamboos and further experiments are being undertaken. The digestion of the materials is effected by the acid sulphite process at the India Paper Pulp Co.'s mill at Naihati and by the alkali process (usually with fractional digestion) at the other mills. The bamboo paper has proved to be of satisfactory quality for most purposes. The future of the Indian paper industry depends on the exploitation and development of bamboo and it is anticipated that paper made from it will eventually be able to dispense with protection; grass also occupies a recognised place in the industry, and should be subject to the same proposals for assistance. The withdrawal of the protective duty at the present time would lead to the disappearance of bamboo as a paper-making material and this would be a national loss; it would also cripple the resources of the Indian mills and endanger their existence.

The Oil Palm in Nigeria

A paper accepted for the 1931 "Annual Bulletin" of the Agricultural Department, Nigeria, describing the conclusions drawn from the study of the yields of the Calabar plantation oil palms in Nigeria. The merits of the ordinary thin-shell palm, as opposed to those of the ordinary thick-shell palm, depends upon the yield and upon the proportion of the mesocarp oil that can be extracted from the fruit. With native methods of oil extraction, and with the observed differences between the yields of these two sub-types, the ordinary thick-shell form is the more valuable palm. With an improved method of oil extraction, having the efficiency of the cooker-press, the ordinary thin-shell form is slightly the more valuable, and definitely so with factory extraction. The yield of fruit per palm and the oil content of the fruit are equal in value. The possibility of growing thin-shell palms with a high oil content on native plantations depends entirely upon the successful development of the cooker-press process, or of similar improved method for oil extraction by native farmers. Without such a process thin-shell palms are less valuable than thick-shell palms on account of the lower yield of fruit per palm, the low proportion of the oil of thin-shell fruit that is recovered by native extraction methods, and of the lower yield of kernels from thin-shell fruit. When equal weights of fruit are treated, the cooker-press process of oil extraction gives an increase of approximately 50 per cent. over the native washing method for the fruit of the ordinary thick-shell and green-fruited thick-shell palms. For the fruit of the mantled thick-shell palms, and for all the thin-shell forms, the increase obtained with the cooker-press is in the neighbourhood of 100 per cent.

According to the report of the Chemical Branch, Southern Provinces, the process employed in pressing the palm fruit has now been considered to have been brought as closely as possible into line with native farmers' needs and the labour has been reduced to a minimum. It has been found that by drying the nuts and fibre after the initial pressing the subsequent separation is much more readily effected When the moisture content of the fibre has fallen from the normal 35 per cent. to about 25 per cent. the fibre no longer adheres closely to the nuts, and the conditions for separation are considerably improved. By utilising the differences in frictional resistance of nuts and fibre to a rough surface a simple and rapid method of separation has been found. The separation is carried out on a wooden board supported at one end so as to slope at an angle of 30°-40°. The dried fruit is piled in successive lots on the high end of the board. The nuts, almost fibre free, roll to the bottom, and by agitation of the mass the speedy separation of nuts and fibre is effected. Any chunks of fibre which may roll down as separation proceeds are picked out without difficulty. In this way some 200 lb. of fruit may be separated in an hour on a 6 ft. by 3 ft. board. The drying process is carried out simultaneously with separation. The separated pulp is warmed and again

pressed. In this way 80-85 per cent. of the available oil can be extracted. Efficiencies approaching 90 per cent. may be reached by third and fourth pressings, but only at the expense of a high labour-to-yield ratio.

Improvement of Fiji Copra

Coconuts are one of the main crops in the Fiji Islands and large quantities of copra are exported every year, the amount in 1930 being 23,882 tons valued at £369,524. Fiji copra, however, is of inferior quality, with the result that it commands a comparatively low price. With a view to obtaining higher prices, steps are being taken by the Department of Agriculture to improve the quality by the adoption of more careful methods of preparation and are described in "Fiji Agricultural Journal," 1931, Vol. 4, No. 3. The poor quality of Fiji copra is due to the large proportion of very low-grade materials it contains. This inferior copra is mainly produced by natives using primitive methods from nuts grown on palms which have received no cultivation. The nuts used are usually old and in many cases have germinated. During the drying of the copra in most cases no steps are taken to protect the nuts from rain, with the result that the material becomes mouldy and rapidly deteriorates. With some natives it is also customary to sell green copra (*i.e.*, pieces of undried nuts) or to mix it with properly cured copra. In either case sweating occurs and a product of poor quality results.

As some Fiji planters already sulphur their copra with beneficial results and in other countries sulphuring has been used with good results for some years, it was decided to try this method for native copra. For this purpose a portable sulphuring chamber, having a capacity of 1,000—1,500 nuts (equivalent to about 5 cwt. of dry copra) was used. Trays with bottoms of wire-netting were used to hold the nuts, and at the bottom of the chamber was placed the burner for flowers of sulphur mixed with fibre from the coconut husks.

From the results of these experiments it was concluded that copra which had been sulphured and dried with protection from rain and covered at night was of rather better quality than ordinary sun-dried copra similarly protected. The sulphured product had a cleaner and whiter appearance; it kept better on storage; it dried to a better quality copra under high humidity conditions; and it was a little less liable to attack by insects on storage. It, however, was not as brittle as a good quality sun-dried sample, being generally leathery and bending rather than fracturing, which may be a disadvantage from the crusher's point of view.

Sulphuring does not exert any protective influence on copra if the nuts are dried without being covered at night and during rain. Sulphured and uncovered nuts do not resist the attack of moulds during drying and are more attractive to copra beetles. Sulphuring does not improve copra which is neglected during drying. Nuts that had received a preliminary washing with a solution of sodium carbonate, when sulphured before drying gave copra of slightly better appearance than that prepared from nuts which were treated with caustic soda before sulphuring and drying. The main advantage of washing the nuts with a solution of sodium carbonate before sulphuring and drying was that on storage even for as long as a year the resulting copra successfully resisted all mould and insect attack.

Washing green copra in a 10 per cent. solution of sodium carbonate and then subjecting it while still wet to the fumes of burning sulphur seems to offer possibilities for adoption for commercial use. The advantages are the facility and cheapness with which carbonate of soda can be obtained; the clean appearance and high quality of the resulting copra; the prevention of mould and insect attack and therefore a reduction of the loss in weight on storing the product.

Alum in the Tanning Industry

Official Method of Analysis

THE Miscellaneous Tannery Materials Committee of the American Leather Chemists' Association has recommended the following method for the analysis of alum to be the official method of the Association:—("J. Amer. Leather Chem. Assoc.," 1932, 27, p. 269).

Insoluble matter: 20 grms. are dissolved in hot water, and the solution filtered through a weighed Gooch crucible, well washed with hot water, and the insoluble matter dried and weighed. The filtrate is made up to 1,000 c.c.

Total alumina: 25 c.c. of the solution are diluted to about 175 c.c., 5 grms. NH_4Cl, 2 c.c. conc. HCl and 4 c.c. conc. HNO_3 added. The liquid is gently boiled, and dilute (1 : 1) NH_4OH added until the alumina is partly precipitated. A few drops of 0.2 per cent. alcoholic methyl red is now added and the precipitation continued until the indicator just turns yellow. Boil for exactly 1 min., filter and wash the precipitate with hot 2 per cent. NH_4Cl or NH_4NO_3. The precipitate is heated gradually to full heat for 1 hour, and then over a blow lamp for 5 min. The precipitate gives $Al_2O_3 + Fe_2O_3$. If other sulphates are present, re-precipitation is necessary, finally washing with water. Allowance is made for the Fe_2O_3 determined as below.

Total iron: 10 grms. are dissolved in 500 c.c. of water, 2-3 c.c. conc. H_2SO_4 added, and while warm, 0.1N, $KMnO_4$ added until just pink. The total iron is then reduced either by SO_2 or in a Jones reductor, and determined by titration with 0.1N, $KMnO_4$.

Ferric iron: 50 c.c. of the above mentioned solution are treated with 5 c.c. H_2SO_4 and 20 c.c. 1 per cent. KCNS or NH_4CNS solution, diluted to 100 c.c. and the colour matched against a standard ferric iron solution, of which 1 c.c. = 0.0001 grm. Fe_2O_3 (0.5 grm. $Fe(NH_4)_2(SO_4)_3$ with 50 c.c. water and 20 c.c. dil (1 : 1) H_2SO_4 oxidised by $KMnO_4$ and made up to 1,000 c.c.

Sulphate: 50 c.c. of the analytical solution, are diluted to 350 c.c., 2 c.c. of 2 per cent. HCl added, and when boiling, 25 c.c. of boiling 10 per cent. $BaCl_2$ solution run in. Set aside overnight at room temperature, then filter and thoroughly wash with hot water. The precipitate is slowly ignited without allowing the paper to catch fire, and then completely ignited, cooled and weighed. If reduction takes place, due to rapid heating, the precipitate is moistened with conc. H_2SO_4, re-ignited and weighed.

Ferrous and ferric iron are calculated to the respective sulphates, the SO_3 used deducted from the total SO_3 the remainder of which is calculated to $Al_2(SO_4)_3$. If more than the required Al_2O_3 is present, the excess is reported as basic Al_2O_3. If any excess of SO_3 is present above that required for the bases it is reported as free H_2SO_4.

For routine analysis, *basic alumina* is estimated by the following methods:—Ten gms. are dissolved in water, filtered if necessary, and made up to 500 c.c.; 25 c.c. are diluted with 25 c.c. recently boiled and cooled distilled water and exactly 2 c.c. of 0.294N, H_2SO_4 added with 3 drops of 1 per cent. phenol phthalein solution. 30 c.c. KF solution (see below) are run in, and after 3-4 secs. whirling to mix, the solution is titrated with 0.294 N. NaOH until the pink tint is permanent for 1 minute. A blank test is run with distilled water. If less than 2 c.c. of NaOH is required, the sample is basic, and the acid consumed represents the percentage of basic Al_2O_3. If more than 2c.c. NaOH is required, the sample is acid, and the excess × 2.88 is the percentage of free $_2SO_4$. The KF solution is prepared by dissolving 960 gms. of KF or 1,600 gms. $KF.2H_2O$ in 8 litres recently boiled distilled water, 16c.c. phenol phthalein solution added and then CO_2 free 50 per cent. NaOH until just pink 5c.c. in excess. Filter and dilute to s.g. 1.052 at 60° F. or 1,050 at 70° F. Finally neutralise with pure HF.

In the estimation of *combined alumina*, 50c.c. of the solutino from the basic alumina estimated is diluted with 50c.c. water, and exactly 5 drops of phenol phthalein solution added from a 4 mm. bore tube. Heat to boil and add slowly 5 c.c. of saturated $BaCl_2$ solution. Then titrate with 0.249 N. NaOH until pink, heat to boil and continue the titration until the faint pink end point is reached. The percentage of combined alumina is calculated as follows:—(1) Basic sample, c.c. NaOH/2 — (0.47 FeO + 0.64 Fe_2O_3): (2) acid sample, c.c. NaOH/2 — (0.47 FeO + 0.64 Fe_2O_3 + 0.347 H_2SO_4).

The British Association Meeting

Programme for the Chemistry Section

THE British Association for the Advancement of Science will hold their 1932 meeting at York, from August 31 to September 7. The inaugural general meeting, at which the presidential address will be given by Sir Alfred Ewing, F.R.S., will be held in the Exhibition Hall on the evening of the opening day (Wednesday, August 31) at 8 p.m. The Lord Mayor of York (The Rt. Hon. R. H. Vernon Wragge, J.P.), and the Sheriff (Mr. Arnold S. Rowntree) invite members of the association to a reception in the Exhibition Buildings on Thursday, September 1, at 8.30 p.m.

The foreign guests of the Section B (Chemistry) will be entertained at dinner in the Masonic Hall, Duncombe Place, on Friday, September 2, at 7 p.m. Those desiring to attend this dinner (which is for men only and is limited to 70) must notify the local secretary of the section (Mr. C. E. L. Livesey, 62 Bootham Crescent, York) before August 25. Tickets, excluding wine but including gratuities, are 7s. 6d.

The various meetings of the Chemistry Section will be held at Bootham School, where the sectional presidential address will be delivered by Dr. W. H. Mills, F.R.S., on "Some Aspects of Stereo-chemistry" (Thursday, September 1, at 10 a.m.). Contributions to the subsequent discussion on stereo-chemistry will include Professor Dr. J. Meisenheimer on "The Stereo-chemistry of Oximes, Hydroxylamines and Amine-oxides"; T. W. J. Taylor and L. E. Sutton on "The Configurations of the Oximes from Measurement of Electric Di-pole Moment"; Dr. N. V. Sidgwick, F.R.S., on "Molecular Di-pole Moments and Inter-valency Angles"; Dr. F. G. Mann on "Chemical Evidence on the Configuration of the 4-co-valent compounds of the Metals of the Platinum Group"; Dr. S. Sugden on "Planar Configuration of diamagnetic Nickel Complexes"; and J. D. Bernal on "Crystal Structure and Stereo-chemistry."

On Friday, September 2, at 10 a.m., there will be a discussion on "The Constitution of Polysaccharides with special reference to Fibres," introduced by Professor W. N. Haworth, F.R.S. Contribution to this discussion will include Professor Dr. Max Bergman on "Molecular Weight of Cellulose and its Intermediate Hydrolysis Products"; Professor Dr. H. Staudinger on "The Nature and size of the Colloid Particles of Cellulose and Related Substances"; Dr. E. L. Hirst on "Amylise and Amylopectin"; Professor Dr. H. Mark on "The space model of cellulose"; W. T. Astbury on "Protein fibres and the formation of polysaccharide chains." At 8 p.m. on Friday evening there will be a discussion by Sir Arthur W. Hill, F.R.S., on "Plant Products of the Empire in Relation to Human Needs"; for this discourse, which will be held in the Co-operative Hall, special tickets are required.

A discussion on "Water Pollution" will taken place on Monday, September 5, at 10 a.m., including contributions by Professor G. C. Bourne, F.R.S., on "The purpose and nature of the survey of the River Tees"; J. Longwell on "The decomposition of sewage in river water"; Dr. R. W. Butcher and F. T. K. Pentelow on "The effects of pollution on the biology of the non-tidal reaches of the River Tees"; Dr. B. A. Southgate on "Effects of sewage and industrial pollution."

On Tuesday, September 6, at 10 a.m., Professor C. H. Desch, F.R.S., will deal with "Re-arrangements in the solid states." At 10.45 a.m. there will be a discussion on "Liquid mixtures," including Professor Irvine Masson on "Phenomena in liquid mixtures"; Professor J. Kendall, F.R.S., "Compound formation in liquid mixtures"; and Dr. N. V. Sidgwick, F.R.S., on "Di-pole association in liquid mixtures."

Excursions arranged for the Chemistry Section will include a visit to the Fertiliser and Synthetic Products Works of Imperial Chemical Industries, Ltd., at Billingham (Saturday, September 3, 10.5 a.m.), and one to the British Oil and Cake Mills, Ltd., at Hull (Monday, September 5, 1.55 p.m.) In connection with the visit to the works at Billingham, the terms of the invitation make it necessary to prepare in advance a list of those proposing to join the party, which may not include any person associated with the synthetic nitrogen industry. Members desiring to make this visit must send their names to the local secretary of the section (Mr. C. E. L. Livesey, 62 Bootham Crescent, York) before August 25.

A New Refrigerant

"Freon"—Dichlorodifluoromethane

THE ideal refrigerant is one which is neither inflammable nor toxic nor capable of entering into dangerous chemical reactions, which can be operated at relatively low pressures and which is efficient and suitable for industrial, commercial and household refrigerating systems. "Freon," or dichlorodifluoromethane, which is described in "Ind. Eng. Chem.," 1932, *24*, 620, was developed in a deliberate attempt to produce, by chemical arrangement, a refrigerant from which these hazards are eliminated and which still has properties favourable to economic operation. It is a colourless, almost odourless gas and when liquefied, boils at -21.7° F. Expressed chemically, it is prepared by taking carbon tetrachloride and replacing two of the chorine atoms with two atoms of fluorine.

Freon leaks are detected by a novel apparatus known as a halide lamp. The lamp may be described as a torch burning alcohol which gives an almost invisible flame under ordinary conditions. If, however, air containing Freon is fed into the base of the lamp and the flame permitted to impinge upon a piece of metallic copper, it changes from colourless to a bright green; this test will disclose a concentration as low as 0.01 per cent. Freon, itself, is non-inflammable and non-explosive; in fact its vapour has fire extinguishing properties. It is non-toxic and non-irritating; test animals lived for weeks in an atmosphere containing 20 per cent. by volume without experiencing any harmful physical effect, either immediate or delayed. It is not absorbed by foods or materials being refrigerated, and has no effect on flowers, fruit, vegetables, dairy products or furs.

Tung Oil in the United States

Notable Expansions at Plantations

THE establishment of the tung oil industry in the United States has been so successful during the last few years that a move is now being made to expand it on such a scale that America will cease to be dependent on China for even small quantities of this commodity. Dr. H. A. Gardner has recently described the position in a paper before the American Chemical Society (Science Service, Washington). Tung oil is essentially an oriental product, used through the ages by the Chinese for making native lacquer and ink. It is manufactured from the seeds of a deciduous tree, *Aleurites*, native to China, on much the same principle as peanut oil is produced by milling from peanuts in that country. Seeds were first introduced into America through the agency of the U.S. Department of Agriculture in 1905, and planted at the Government Experimental Station then at Chico, California. Extensive plantings, however, were not made until some eight years ago in the southern States, which were so successful that already 25,000 acres of land have been given over to the industry. The American Paint and Varnish Association is particularly concerned with this venture, as the oil is a valuable ingredient of varnishes and varnish paints. Apart from these uses, the American industries have extended considerably the application of tung oil, and it is now employed in the manufacture of insulating compounds, brake linings, linoleum, waterproofing fabrics, as a binder for wall board and plastic synthetic lumber, primers, synthetic resins, battery jars, etc.

Rhenium and Gallium

New Source for Commercial Development

BOTH rhenium and gallium are now being isolated on a technical scale from waste products in the working-up of cupriferous slate deposits in the Mansfeld area. Not more than 0.0002 per cent. of rhenium is present in the original raw material, while the gallium content is even smaller. These extremely small percentages are reflected in the current gallium and rhenium prices of 10,000 and 14,000 marks per kilo. respectively. It is estimated that the Leopoldshall works of the Vereinigte Chemische Fabriken are capable of turning out 150 kilos of rhenium per annum. In addition to its possible use as a catalyst, rhenium has been exploited in thermo-element design, platinum-platinum, with rhenium elements being distinguished by high thermal efficiency at constant voltage.

British Overseas Chemical Trade in July

Decline in Exports and Imports

Exports of chemicals, drugs, dyes and colours during July amounted to a total of £1,445,804, being £125,511 lower than the figures for July, 1931. Imports totalling £740,616 were lower by £224,356, and re-exports totalling £34,283 were lower by £24,827, as compared with July, 1931.

	Quantities. Month ended July 30, 1931.	Quantities. Month ended July 30, 1932.	Value. Month ended July 30, 1931. £	Value. Month ended July 30, 1932. £
Imports.				
Acetic Anhydride .. cwt.	562	551	1,654	1,524
Acid, Acetic	828	438	30,226	14,250
Acid, Tartaric, including Tartrates .. cwt.	4,377	2,358	21,073	9,859
Bleaching Materials ..	9,842	3,153	14,058	3,806
Borax	18,683	11,400	11,116	5,979
Calcium Carbide	58,510	45,430	36,187	28,448
Coal Tar Products, not elsewhere specified val.	—	—	2,188	2,190
Glycerine, Crude .. cwt.	—	100	—	155
Glycerine, Distilled ..	1,723	524	3,466	909
Red Lead and Orange Lead	2,700	1,828	3,617	1,898
Nickel Oxide	—	—	—	—
Potassium Nitrate (Saltpetre) .. .. cwt.	8,418	7,797	7,473	6,076
Other Potassium Compounds .. .. cwt.	71,875	286,614	42,366	136,791
Sodium Nitrate	88,530	7	38,947	5
Other Sodium Compounds cwt.	34,771	16,643	22,255	11,617
Tartar, Cream of	1,951	1,095	7,580	3,968
Zinc Oxide .. tons	636	11	13,945	245
Other Chemical Manufactures .. .. value	—	—	277,817	192,059
Quinine and Quinine Salts oz.	87,953	10,017	7,474	1,037
Bark Cinchona (Bark Peruvian, etc.) .. cwt.	1,280	1,327	5,249	8,186
Other Drugs .. value	—	—	82,814	83,956
Intermediate Coal Tar Products .. cwt.	107	304	1,097	3,799
Alizarine and Alizarine Red .. .. cwt.	—	—	—	—
Indigo, Synthetic ..	—	—	—	—
Other Dyestuffs	4,236	2,843	103,979	64,876
Cutch	3,593	973	5,036	1,032
Other Extracts for Dyeing cwt.	2,058	1,303	6,404	3,846
Indigo, Natural	27	—	766	—
Extracts for Tanning ..	81,742	90,229	70,477	64,788
Barytes, Ground	45,152	24,874	8,699	4,920
White Lead (Dry) ..	13,829	4,703	19,189	5,891
Other painters' colours and materials .. cwt.	119,944	69,056	128,220	87,400
TOTAL .. value	—	—	973,972	749,616
Exports.				
Acid, Sulphuric .. cwt.	1,592	4,603	1,703	2,495
Acid, Tartaric, including Tartrates .. cwt.	735	856	3,042	3,763
Ammonium Chloride (Muriate) .. tons	556	314	8,300	5,189
Ammonium Sulphate ..	26,102	50,540	180,395	230,485
Bleaching Powder (Chloride of Lime .. cwt.	45,537	77,523	13,828	23,339
COAL TAR PRODUCTS—				
Anthracene .. cwt.	—	—	—	—
Benzol and Toluol gal.	192,834	4,840	17,167	379
Carbolic Acid (Crude)	4,640 gal.	11,859 gal.	458	1,140
Carbolic Acid (Crystals) Cresylic Acid .. gal.	78,097	77,899	7,845	7,902
Naphtha	—	3,662	—	268
Naphthalene (excluding Naphthalene Oil) cwt.	14,899	2,287	3,149	722
Tar Oil, Creosote Oil, etc. .. .. gal.	1,433,537	3,096,120	23,059	55,810
Other Sorts .. cwt.	12,824	20,654	7,841	7,375
COAL TAR PRODUCTS	—	—	62,598	75,500
Copper, Sulphate of tons	2,484	3,525	44,456	55,476
Disinfectants, Insecticides, etc. .. .. cwt.	27,823	19,719	65,043	47,670
Glycerine, Crude .. cwt.	1,466	2,079	1,573	2,030
Glycerine, Distilled ..	10,648	9,569	26,232	20,446
Potassium Chromate and Bichromate .. cwt.	1,561	979	3,168	2,314
Potassium Nitrate (Saltpetre) .. cwt.	1,215	1,039	2,036	1,656
Other Potassium Compounds .. .. cwt.	916	941	11,917	5,439
Sodium Carbonate including Crystals, Ash and and Bicarbonate cwt.	423,106	302,949	117,167	84,573
Caustic Soda	213,918	168,572	138,099	103,831
Sodium Chromate and Bichromate .. cwt.	1,829	1,619	2,959	3,263
Sodium Sulphate, including Salt Cake .. cwt.	37,251	37,459	4,929	4,177
Other Sodium Compounds cwt.	68,474	43,131	74,385	57,992
Zinc Oxide .. tons	584	1,032	12,722	19,528
Other Chemical Manufactures .. .. value	—	—	240,429	193,098
Quinine and Quinine Salts	207,926	221,411	19,071	22,907
Other Drugs .. value	—	—	212,997	189,698
Dyes and Dyestuffs (Coal Tar) .. .. cwt.	12,034	10,768	94,663	103,063
Other Dyestuffs	7,585	9,640	6,886	9,276
Barytes, Ground	1,035	2,098	630	1,159
White Lead (Dry) ..	2,135	1,749	3,755	3,082
Paints and Colours in paste form .. .. cwt.	23,662	18,805	43,735	31,407
Paints and Enamels prepared .. .. cwt.	34,021	26,113	100,563	77,233
Other painters' colours and materials .. cwt.	38,508	38,285	66,843	64,715
TOTAL .. value	—	—	1,571,315	1,445,804
Re-Exports.				
Acid, Tartaric, including Tartrates .. cwt.	75	25	439	155
Borax	1,166	18	636	13
Coal Tar Products, not elsewhere specified value	—	—	140	8
Potassium Nitrate (Saltpetre) .. .. cwt.	67	23	80	38
Sodium Nitrate	792	70	334	30
Tartar, Cream of	353	89	1,507	439
Other Chemical Manufactures .. .. value	—	—	18,788	7,387
Quinine and Quinine Salts oz.	7,598	5,807	691	866
Bark Cinchona (Bark Peruvian, etc.) .. cwt.	147	284	754	2,540
Other Drugs .. value	—	—	27,189	15,142
Cutch .. .. cwt.	1,068	45	1,614	60
Other Extracts for Dyeing cwt.	175	45	1,177	501
Indigo, Natural	7	0	205	130
Extracts for Tanning ..	2,140	604	2,704	559
Painters' colours and materials .. .. cwt.	750	279	2,192	595
TOTAL .. value	—	—	59,110	34,283

Production of Linseed Oil in Sweden

THE linoleum industry in Sweden consumes large quantities of linseed oil, and for this reason the linseed oil industry is well-established in that country. The output of linseed oil by the domestic industry in 1929 (the latest year for which production statistics are available) was 5,600,000 kilos of raw linseed oil and 6,800,000 kilos of boiled linseed oil. Five important firms manufacture the raw linseed oil, of which three are located in Western Sweden, while nine establishments produce the boiled product.

Some Notes on Platicisers

By REX CAMPBELL

FROM a practical it is sometimes asked what the function of a plasticiser is in a film, and why a plasticiser is necessary. E. C. Bingham, however, has indicated the nature of this problem in his book on "Fluidity and Plasticity." A plastic solid is made up of particles which touch each other at certain points. In a lacquer film the space between the particles may be empty or filled with gas liquid or amorphous solid. The particles glide over each other according to the ordinary laws of friction, and it is not necessary that they should touch each other at a maximum number of points, or in other words, that they should be "close-packing." On the contrary, this has the effect of preventing flow from taking place, with a consequent breakdown of the film. In a plastic solid the particles should touch each other so as to form arches capable of carrying the load. In a film of cellulose nitrate lacquer, for instance, if there is insufficient plasticiser the close-packing of the particles of the other ingredients results in early film disintegration in one form or another. If there is too much plasticiser—that is, if the spaces between the particles are too large—the load is not carried, with consequent seepage and loss of tensile strength.

Correct Plasticising

The problem of correct plasticising and the problem of filling the spaces between particles in such a way and with such a medium that the relationship of each particle to the other has balanced, applies equally to each film of lacquer undercoat, primers, fillers, etc. The nature of the material to be painted or lacquered should be considered in regard to the plasticity of the film. Preventions of the vibrations or shocks to which the finished article has also to be subjected should be borne in mind. The elasticity resulting from correctly adjusted plasticising enables the film to contract or expand with the substance upon which it is applied, thus eliminating cracking and peeling from the surface. The film is rendered capable of remaining intact for long periods on surfaces which undergo considerable vibrations. The pliability thus given to a film contributes the equally important properties of toughness and its adhesion to the surface coated.

There is, therefore, a perpetual search for the ideal plasticiser, and until it has been found the advantages of the available mediums must be combined together. Although the ideal plasticiser does not yet exist it is interesting to define what it should be, in order that we may effectively combine the best of the products at present available. In the first place, it should be a colourless non-hydroscopic and non-volatile material or liquid, being a solvent for cellulose and wholly miscible with other lacquer ingredients. It should impart plasticity to the film. Just as nitro-cellulose is the basis of modern lacquer, and a solvent can be called a liquid which brings the nitro-cellulose into colloidal solution, so a plasticiser is an ingredient imparting plasticity to the dried film.

Advantages and Disadvantages

The objection to the solid form of triphenyl phosphate has now been overcome. Castor oil gives, with the exception of amyl and butyl stearite, the most elastic films, but their non-solvent power should be remembered. Although adipates, and to a small extent the oxalates, have their uses, di-butyl phthalate and tricresyl phosphate seem to be employed more widely. As to how the various advantages of the accepted plasticisers can effectively be combined for use in nitro-cellulose formulæ practical testing alone will show. Opinions differ very much, but there seemed to be agreement that the number worth working on for reasons of price and properties are few; that good results are obtained with the use of mixed plasticisers—synthetic with synthetic; and that good results are obtained when plasticisers are mixed—synthetic with oil plasticisers or softeners.

As the qualities and properties of the narrow range of plasticisers which can be used commercially are well-known it is not necessary to refer to them in detail. It should be noted, however, that those plasticisers which have special advantages have also disadvantages, whereas those with no disadvantages have no advantages either. The problem has therefore been to so formulate a lacquer that it combines the advantages of individual plasticisers and eliminates their disadvantages. On the basis of this, the following tabulation is given for comparisons:—

Plasticisers for Cellulose Nitrate Lacquers.

	ADVANTAGES.	DISADVANTAGES.
Di-Butyl Phthalate	Light-fast; good solvent power.	Rapid evaporation.
Tricresyl Phosphate	Almost non-volatile; good solvent power produces tough film.	Not light-fast.
Castor Oil	Almost non-volatile, superior elasticity, excellent cheapness.	No solvent power, poor colour.
Methyl Rexalin Adipate	Good solvent power, stable.	
Oxalates	Good solvent power.	
Butyl Stearate	Excellent elasticity.	No solvent power.

Plasticisers for Cellulose Acetate Lacquers.

	ADVANTAGES.	DISADVANTAGES.
Triphenyl Phosphate	Produces good film, good solvent power.	
Di-Ethyl Phthalate	Produces tough film.	Rapid evaporation.
Triacetin	Good solvent power.	Affinity for water.
Benzyl Alcohol	Produces tough film.	Rapid evaporation.

Plastic Resins

It is well-known that the usual gums and resins—not excluding synthetic resins—while contributing adhesion, durability and gloss to a lacquer, reduce its elasticity. With synthetic or true plasticisers recent research has shown that although themselves solvents of cellulose nitrate they do not appear by any means to have all the combination action on resins that is to be desired. This failing must to some extent explain film disintegration. To overcome his difficulty it has, however, been claimed that the typical properties of resin and plasticiser can be united, and a number of synthetic resins are offered. Some of the claims for these are extravagant, but there are resins which with improvement may be likely to achieve this unity of purpose. At present the products seem to retard drying to the extent that after weeks, and sometimes months, the lacquer film cannot be said to be rock-hard. Such plastic resins at present appear to be more interesting for leather and artificial leather finishes. They probably have a future in all varnishes and lacquers in their dual capacity.

Undoubtedly one of the greatest disadvantages of cellulose lacquer finishes is the early disintegration of transparent lacquer films upon exposure to ultra-violet light; recent research has been directed towards discovering a suitable plasticiser to render clear films completely, or at any rate more resistent to the action of light. The problem remains to the lacquer research technologist, and a solution would be welcomed by the lacquer industry, but improved plasticisers alone will not contribute to it. Without question, however, the diversity of application of cellulose lacquers is due in a very large measure to successful plasticising.

Nitrogen Production in Italy

PRODUCTION of nitrogen fertilisers in Italy amounted to 180,699 metric tons in 1931, as compared with 195,064 in the preceding year. Consumption of ammonium sulphate increased slightly from 102,308 to 105,056 tons. Sales of calcium nitrate, 31,705 tons in 1931, were somewhat less than the 32,758 tons recorded in sales for the preceding year. The consumption of sodium nitrate declined from 75,000 tons in 1930 to 55,000 tons in 1931. Except for sodium nitrate, prices of nitrogen fertilisers in the last year were lower than in 1930. Italy's production of cyanamide amounted in 1931 to 88,066 tons, of which 25,166 tons were furnished by the Societa Italiana Prodotti Azotati. Existing plants have facilities for producing twice the current total of consumption.

South African Chemical Notes

Recent Trade Developments

ABOUT three months ago the South African Government selected several chemical trade items upon which to impose special exchange dumping duties, and the articles in the new schedule include butter substitutes, margarine, compound lard and vegetable fats, and similar substances for use as food or for cooking; deodorised or hydrogenated refined vegetable fats, in bulk for use in the confectionery and biscuit industries; oil meal; arsenate of lead; emulsified asphalt or bitumen, emulsions of tar-bitumen compound, and emulsions of tar. Dumping duties have been imposed on several classes of Japanese goods, and among those of interest to the chemical trades are vegetable and animal oils (excluding cod liver oil and linseed oil); floor, furniture, leather and metal polishes and dressings, including blacking; soap, soap powder and extracts. Indian exports to South Africa have also fallen under the ban of the Government, and among the items of interest to the chemical trade are vegetable and animal oils, paints and colours (excluding artists' colours and dry pigments); soap, soap powder and extracts.

Synthetic Ammonia and Nitric Acid

South Africa is now independent of outside sources for ammonia, for all its needs in this direction are served by the synthetic processes followed at the Modderfontein Dynamite factory, the new works which were erected principally to obtain nitric acid for making explosives. Previously the nitric acid required was obtained by treating Chilean nitrate with sulphuric acid, and the company had imported annually 18,000 tons of sulphur and 7,000 tons of sulphur. In the new factory only air, water and coke are needed, and about 14,600 tons of coke will be used annually. The factory is producing about 14 tons of gaseous ammonia a day and a large quantity of "liquid" ammonia. About half the production is sent by rail to Somerset West, near Cape Town, for the manufacture of explosives and fertilisers.

New Baking Powder Factory

A well-known baking powder company has opened a new factory at Paarl, the plant being said to be the largest of its kind in the southern hemisphere. The cream of tartar factory was put up first, but with the completion of the baking powder factory it becomes a self-contained unit. As far as possible, supplies will be obtained locally and it will be the policy of the company to employ as many South African European employees as circumstances will allow. The cream of tartar is to be extracted from the lees and argols from Western Province grapes, and the pure edible maize starch of the South African mealie crops. Between £8,000 and £10,000 will be spent annually on lees and argols, for the plant can deal with up to 800,000 lb. of lees and 400,000 lb. of argols annually.

Export of Salt

The export of salt may become one of the main trade lines of the South-West African Territory, for at Cape Cross, 80 miles north of Swakomund, there is a salt pan nine miles long and six miles wide. This has been estimated to contain 14,000,000 tons of lime salt and 8,000,000 tons of rock salt. If the attempts to develop the export of salt are successful, the poverty-striken mandated territory may at last succeed in lifting itself into comparative prosperity. The railway administration has agreed to run a weekly motor transportation service from Swakopmund to Cape Cross, and it is hoped shortly to begin production at the rate of 100 tons a month, most of which should be disposed of in the territory, which at present imports all its salt.

Alcohol from Maize

South Africa has yet to lose interest in the manufacture of alcohol from maize, for another company has been registered in Pretoria. This is known as the South African Exploration and Finance Co. (Pty), Ltd., and its capital is £5,000. Two of the directors own a patent process for the manufacture of alcohol from maize, maize cobs and various vegetables and similar matter. The company also intends to produce such by-products as cattle feed, yeast and various types of fertiliser.

Fertilisers in Italy

Formation of New Association to Safeguard Trade

THE National Technical Committee of the Italian fertiliser trade met in Rome on May 18 and voted the formation of an association, to be known as the National Association for Safeguarding Trade in Fertilisers and Products Used by Agriculture (Associazione Nazionale per la Tutela del Commercio dei Concimi e Proditti Utili all' Agricoltura). This association is now connected with the General Confederation of Trade and proposes to organise and direct the movement of trade in fertiliser materials through fertiliser dealers, and to protect the legitimate interests of the individual fertiliser merchants. According to official statistics, 60 per cent. of the products consumed by agriculture is distributed through small individual dealers. It appears that in dealing with the farmers these merchants are in the habit of extending long credit terms. The promoters of the association allege that the merchants have done more than their share toward carrying the farmer financially without government assistance or assistance from the agricultural credit institutes. The co-operative organisations for the distribution of products used by farmers are extremely strong in Italy, and it is evident that the object of the above association is to permit the private fertiliser merchants to unite their strength in competition with co-operative distribution.

Orange Oil Industry in South Africa

Rapid Expansion Reported

CITRUS fruit cultivation in South Africa has shown remarkable expansion during the last ten years. The increased production, particularly of oranges, and the demand in overseas markets for only high quality graded fruit brought to the attention of South African growers the necessity for profitably utilising cull or non-exportable portions of the crop. Experiments in the production of sweet orange oil conducted since 1929 tended to demonstrate the favourable prospects of commercial distillation activity. The large orange cull and surplus fruit in 1930, amounting to nearly 30,000 tons of fruit in the Transvaal alone, prompted definite efforts to establish a local industry. Recent reports have indicated beginning of orange oil manufacture on a commercial scale and the development of perfume production in the Union specifically to utilise the locally produced orange oil. Exhaustive research relative to distillation procedure and oil yields has been conducted and manufacture of orange oil in South Africa has apparently been initiated with improved processes and methods worthy of the attention of American citrus products interests.

Guide to Official Statistics

Issue of a New Volume

EACH year sees the publication of a wide range of Government surveys, returns and reports on all kinds of subjects of international, national or local importance. Hundreds of these contain statistics which are constantly needed by persons engaged in the study of some question on which authoritative information is essential. In the absence of a systematic index to this vast store of statistical material, the individual inquirer would find it very difficult to discover which official publications contained precisely the information he required.

The necessary clue is provided by the annual "Guide to Current Official Statistics," prepared by the Permanent Consultative Committee on Official Statistics, Treasury Chambers, Whitehall, London, S.W.1. The guide contains not only a list of the titles and prices of the statistical volumes issued by each Government Department, but also an alphabetical index of their contents, with particulars of the degree of detail in which the subject is treated and the time and place to which the statistics relate.

Volume X of the guide (price 1s. net, post free 1s. 5d., pp. 357) has just been issued, and may be obtained direct from the sale offices of H.M. Stationery Office or through any bookseller.

News from the Allied Industries

Match Trade

THE INTERNATIONAL RECONSTRUCTION COMMITTEE, representative of the various interests in the Swedish Match Co., in England, America, France, Sweden, and other countries, met at Stockholm, on August 15, to consider the future of the company. The English representatives were Sir Arthur Worley, chairman of the Protection Committee formed by the English owners of shares, and Mr. Bartholomew, a director of Bryant and May, Ltd. M. Djorn Prytz was elected chairman of the conference. The deliberations, which will last for several days, take place in camera.

Mineral Oil

WELL-INFORMED QUARTERS IN PARIS are sceptical regarding Soviet Russia's contribution to the forthcoming International Oil Conference in New York. In view of their absence from the recent oil conference in Paris the Soviet consent to attend the New York meeting had caused satisfaction. This has waned, however, since Moscow has consolidated its position in the French market by an agreement with a French syndicate comprising nine firms, for the exclusive annual supply of 500,000 tons of crude oil for six years. A similar arrangement has been made between Soviet Russia and Turkish importers, and another is being negotiated with the Germans.

Pottery

BRITISH POTTERY MANUFACTURERS are vitally concerned with the discussions at Ottawa. The Manufacturers' Federation made representations with a view to a higher measure of preference in Dominion and British Indian markets, and the result of the demands is being anxiously awaited, especially as regards Canada. Whereas Canada sends to the United Kingdom substantial quantities of electrical porcelain free of duty, a duty, although preferential, has to be paid on British electrical porcelain imported by the Dominion. Manufacturers complain, too, of the fact that Canada buys only about 57 per cent. of her tableware from Great Britain, the remainder coming mainly from the Continent and Japan. Here again the preference is inadequate. Australia obtains a much larger proportion of her electrical porcelain from the United States than from Great Britain. The British pottery industry is passing through a bad period. Many works are on short time and orders are scarce. The main trouble is that the outlook is very unstable

Iron and Steel

THE NATIONAL FEDERATION OF IRON AND STEEL MANUFACTURERS state that there were fifty-six furnaces in blast at the end of July, thirteen fewer than at the beginning of the month, eight having been damped down and five blown out. The production of pig-iron in July amounted to 292,600 tons, compared with 311,400 tons in June, and 317,000 tons in July, 1931. Production includes 57,500 tons of hematite, 135,300 tons of basic, 81,600 tons of foundry and 11,400 tons of forge pig-iron. The output of steel ingots and castings in July amounted to 430,300 tons, compared with 459,300 tons in June and 428,700 tons in July, 1931.

ALL SECTIONS of the iron and steel market are extremely quiet, and continued acute scarcity of orders is causing grave anxiety. Almost immediate expansion of demand is needed to enable manufacturers to keep plant in its present very moderate state of activity. Producers of most commodities would doubtless reduce quotations if they had reason to believe that such action would induce buying in any volume. Customers are more than ever disinclined to discuss forward business, and are unwilling to pay ruling rates for the small parcels they have to buy to cover early needs. In spite of the further heavy curtailment of output of pig iron, the make is still rather in excess of current requirements.

BY THE DAMPING DOWN of four blast furnaces at the Skinninggrove works of Pease and Partners in order to enable a change to be made in their electrical drive, the number of furnaces in blast in this district is reduced to 11. The coke ovens at the works have also been closed, with the exception of two or three which supply gas to the Cleveland Gas Co., and the Loftus ironstone mines of the firm will be idle while the furnaces are out of blast. The works are expected to be restarted a few weeks hence.

Rubber

THE GOVERNMENT OF THE DUTCH EAST INDIES does not consider the present moment opportune for the re-opening of international discussions upon the rubber situation, according to a ministerial statement made in the People's Council. With regard to suggestions that steps might be taken to develop cotton-growing in Java, the view was expressed that such a development would be attended by considerable risks without offering any great promise for the future. There has been a notable decrease in the rubber production of the Dutch East Indies, and, according to the latest official reports, twenty-seven per cent. of last year's total tappable area has since gone out of production. No fewer than 419 rubber estates have entirely ceased tapping, while 115 others have partially ceased.

China Clay

THE CHINA CLAY STATISTICS for July showed some improvement on the preceding month especially in relation to china clay shipments, which amounted to 43,163 tons, china stone 1,545 tons, ball clay 909 tons, making a total of 45,617, compared with an aggregate tonnage of 44,080 in June.

THE DIRECTORS OF ENGLISH CHINA CLAYS, LTD., report that they are unable to recommend any payment of dividend in respect of the preference shares of the company, in view of the fact that there is no improvement in the depressed conditions of world trade. The total china clay returns for the half-year to June 30, 1932, show a further decline. The directors are, however, pleased to report that finances of the company remain unimpaired, and that its share of the existing trade is being more than maintained.

Glass

EXPORTS OF CZECHOSLOVAK GLASS in 1931 fell to 974 million crowns, compared with 1,154 millions in 1930. In the course of the current year the industrial and trade crisis has produced a further deterioration. Of the 120 glassworks normally in operation, 40 have shut down entirely, while short-time is being worked in many of the others, and a large proportion of the glass workers are unemployed. About 80 per cent. of the total output has to be exported. It normally finds a ready market in practically all the countries of the world, with the United States and England as the two leading customers, these two countries taking about 30 per cent. of exports. Considerable declines were registered in exports to India, South Africa, Argentina, Australia, Brazil, Egypt, Canada, Bulgaria, Hamburg (transit), Italy, Spain, and Turkey. Last year's figures showed an improvement on those for 1929 in the case of Belgium, Denmark, France, Sweden, and Switzerland, but this advance has been lost in the current year.

PILKINGTON BROS., who employ about 10,000 workers at their glass works in St. Helens, are bringing into operation a scheme under which the firm will augment the unemployment and children's benefit of their employees and children's benefit of their employees over 21 years of age whose services cannot be fully utilised. The allowance will take the form of a flat rate for each complete week of unemployment and will be 10s. a week for married men and single men with equal responsibilities, and 6s. for other single men. It is intended that the allowance shall be reduced in cases where the total sum—including ordinary unemployment relief—would be more than 36s. Thus no allowance, taken together with the State insurance payment, will exceed 85 per cent. of the "yard rate" which is paid to labourers in a full normal working week. The scheme will terminate on April 1, 1933.

Indian Sandalwood Trade

THE large sandalwood trade of Madras has suffered to a considerable extent recently by reason of the dumping in India of the Australian substitute of a much lower quality than the Indian wood, at a very cheap price. It is stated that while genuine sandalwood costs about Rs.1,000 per ton, the Australian wood costs only from Rs.200 to Rs.300 per ton. It has further been found out that the Australian wood does not belong to the same botanical variety as the true sandalwood, although it has to some extent the same characteristic odour.

Weekly Prices of British Chemical Products

Review of Current Market Conditions

The following notes on the chemical market conditions in Great Britain are based on direct information supplied by the British manufacturers concerned, and unless otherwise qualified the figures quoted apply to fair quantities, net and naked at makers' works. Where no locality is indicated, the prices are general for the United Kingdom. Particulars of the London chemical market are specially supplied to THE CHEMICAL AGE by R. W. Greeff and Co., Ltd., and Chas. Page and Co., Ltd., and those of the Scottish chemical market by Chas. Tennant and Co., Ltd.

BUSINESS in the London chemical market has been fairly satisfactory and with one or two minor exceptions continues steady to firm. The market for coal tar products remains quiet, prices being firm, with little or no change from last week. No more than minor price fluctuations have to be noted in respect of chemical products on the Manchester market during the past week, and whilst here and there some weakness is in evidence the tendency of most lines is steady. Seasonal holiday influences continue to be reflected in the volume of business that is being placed, but so far as deliveries are concerned these are reasonably satisfactory for the time of the year. It is unfortunate that in the cotton textile industry signs of improvement should coincide with a serious labour crisis. There has been renewed activity in the Scottish heavy chemical market but there are practically no advances in prices.

General Chemicals

ACETONE.—LONDON: £65 to £68 per ton; SCOTLAND: £66 to £68 ex wharf, according to quantity.

ACID, ACETIC.—Tech. 80%, £37 5s. to £39 5s.; pure 80% £38 5s. to £40 5s.; tech., 40%, £19 15s. to £21 15s.; tech., 60%, £28 10s. to £30 10s. SCOTLAND: Glacial 98/100%, £48 to £50; pure 80%, £38 5s.; tech. 80%, £37 5s. d/d buyers' premises Great Britain. MANCHESTER: 80%, commercial, £39; tech. glacial, £52.

ACID, BORIC.—SCOTLAND: Granulated commercial, £26 10s. per ton; B.P. crystals, £35 10s.; B.P. powder, £36 10s. in 1-cwt. bags d d free Great Britain in one-ton lots upwards.

ACID, CHROMIC.—11d. per lb., less 2½%, d/d U.K.

ACID, CITRIC.—1s. 0¾d. per lb. LONDON: 1s. 0¾d., less 5%. MANCHESTER: 1s. to 1s. 0¾d.

ACID CRESYLIC.—97 99%, 1s. 5d. to 1s. 7d. per gal; 99/100%, 1s. 9d. to 2s.

ACID FORMIC.—London: £48 per ton.

ACID, HYDROCHLORIC.—Spot, 3s. 9d. to 6s. carboy d/d according to purity, strength and locality. SCOTLAND: Arsenical quality, 4s.; dearsenicated, 5s. ex works, full wagon loads.

ACID, LACTIC.—LANCASHIRE: Dark tech., 50% by vol., £24 10s per ton; 50% by weight, £28 10s.; pale tech., 50% by vol., £28; 50% by weight, £33; 80% by weight, £53; edible, 50% by vol., £41. One-ton lots ex works, barrels free.

ACID, NITRIC.—80° Tw. spot, £220 to £25 per ton makers' works, according to district and quality. SCOTLAND: 80°, £23 ex station full truck loads.

ACID, OXALIC.—LONDON: £45 10s. per ton in casks, £48 10s. to £52 10s. in kegs. SCOTLAND: 98/100%, £49 to £52 ex store. MANCHESTER: £47, ex store.

ACID, SULPHURIC.—Average prices f.o.r. British makers' works, with slight variations owing to local considerations: 140° Tw. crude acid, £3 per ton; 168° Tw. arsenical £5 10s.; 168° Tw. non-arsenical, £6 15s. SCOTLAND: 144° quality, £3 12s. 6d.; 168°, £7; dearsenicated, 20s. per ton extra.

ACID, TARTARIC.—1s. per lb. SCOTLAND: B.P. crystals, 1s. 1d. to 1s. 1½d., less 5%, carriage paid. MANCHESTER: 1s.

ALUM.—SCOTLAND: Lump potash, £9 per ton ex store.

ALUMINA SULPHATE.—LONDON: £8 5s. to £9 10s. per ton. SCOTLAND: £8 to £8 10s. ex store.

AMMONIA, ANHYDROUS.—Spot, 10d. per lb. d/d in cylinders. SCOTLAND: 10d. to 1s. containers extra and returnable.

AMMONIA LIQUID.—SCOTLAND: 80°, 2¾d. to 3d. per lb. d/d.

AMMONIUM BICHROMATE.—8d. per lb. d/d U.K.

AMMONIUM CARBONATE.—SCOTLAND: Lump, £36 per ton; powdered, £38, in 5-cwt. casks d/d U.K. stations or f.o.b. U.K. ports.

AMMONIUM CHLORIDE.—£37 to £45 per ton, carriage paid. LONDON: Fine white crystals, £19 to £20. (See also Salammoniac.)

AMMONIUM CHLORIDE (MURIATE).—SCOTLAND: British dog tooth crystals, £32 to £35 per ton carriage paid according to quantity. (See also Salammoniac.)

ANTIMONY OXIDE.—SCOTLAND: Spot, £22 per ton, c.i.f. U.K. ports.

ANTIMONY SULPHIDE.—Golden 6½d. to 1s. 1½d. per lb.; crimson, 1s. 4d. to 1s. 6d. per lb. according to quality.

ARSENIC.—LONDON: £24 10s. c.i.f. main U.K. ports for imported material; Cornish nominal, £26 10s. f.o.r. mines. SCOTLAND: White powdered £27 ex wharf; spot, £27 10s. ex store. MANCHESTER: White powdered Cornish, £25 at mines.

ARSENIC SULPHIDE.—Yellow 1s. 6d. to 1s. 8d. per lb.

BARIUM CHLORIDE.—£11 per ton.

BISULPHITE OF LIME.—£7 10s. per ton f.o.r. London, packages free.

BLEACHING POWDER.—Spot 35/37% £7 10s. per ton d/d station in casks, special terms for contract. SCOTLAND: £8 15s. in 5/6 cwt. casks.

BORAX, COMMERCIAL.—Granulated £15 10s. per ton, power £17, packed in 1-cwt. bags, carriage paid any station Great Britain. Prices are for 1-ton lots and upwards.

CADMIUM SULPHIDE.—3s. 6d. to 3s. 9d. per lb.

CALCIUM CHLORIDE.—Solid 70/75% spot £5 5s. to £5 15s. per ton d d station in drums.

CARBON BISULPHIDE.—£30 to £32 per ton, drums extra.

CARBON BLACK.—4½d. to 5¾d. per lb., ex wharf.

CARBON TETRACHLORIDE.—£45 to £55 per ton, drums extra.

CHROMIUM OXIDE.—10d. to 10½d. per lb. according to quantity d/d U.K. Green 1s. 2d. per lb.

CHROMETAN.—Crystals 3¾d. per lb. Liquor £19 10s. per ton d/d.

COPPERAS (GREEN).—SCOTLAND: £3 15s. per ton, f.o.r, or ex works.

CREAM OF TARTAR.—LONDON: £4 10s. per cwt.

FORMALDEHYDE.—LONDON: £28 per ton. SCOTLAND: 40%, £28 10s. ex store.

LAMPBLACK.—£46 to £50 per ton.

LEAD, ACETATE.—LONDON: White, £33 to £34 per ton. Brown £1 per ton less. SCOTLAND: White Crystals £40 to £41 c.i.f. U.K. ports. Brown £1 per ton less. MANCHESTER: White, £35; Brown, £33.

LEAD NITRATE.—£28 per ton. MANCHESTER: £28.

LEAD, RED.—SCOTLAND: £28 10s. per ton d/d buyer's works.

LEAD, WHITE.—SCOTLAND: £40 per ton carriage paid.

LITHOPONE.—30%, £19 to £21 per ton.

MAGNESITE.—SCOTLAND: Ground Calcined £9 per ton ex store.

METHYLATED SPIRIT.—61 O.P. Industrial 1s. 8d. to 2s. 3d. gal. Pyridinised Industrial, 1s. 10d. to 2s. 5d. Mineralised, 2s. 9d. to 3s. 3d. 64 O.P. 1d. extra in all cases. Prices according to quantities. SCOTLAND: Industrial 64 O.P., 1s. 9d. to 2s. 4d.

NICKEL AMMONIUM SULPHATE.—£52 per ton d/d.

NICKEL SULPHATE.—£52 per ton d/d.

PHENOL.—Small lots 6¼d. to 6½d. per lb. in 3-cwt. drums, bulk quantities down to 5½d. per lb., delivery free U.K.

POTASH, CAUSTIC.—LONDON: £42. MANCHESTER: £40.

POTASSIUM BICHROMATE.—Crystals and Granular, 5d. per lb. net d/d U.K. Discount according to quantity. Ground 5¾d. LONDON: 5d. per lb. with usual discounts for contracts. SCOTLAND: 5d. d/d U.K. or c.i.f. Irish Ports. MANCHESTER: 5d.

POTASSIUM CARBONATE.—SCOTLAND: 96/98% spot £28 per ton ex store. LONDON: £31 10s. to £32. MANCHESTER: £29 to £30.

POTASSIUM CHLORATE.—3¾d. per lb. ex wharf London in 1-cwt. kegs. LONDON: £37 to £40 per ton. SCOTLAND: 99¾/100% powder, £34. MANCHESTER: £37.

POTASSIUM CHROMATE.—6½d. per lb. d/d U.K.

POTASSIUM NITRATE.—SCOTLAND: Refined Granulated £28 per ton c.i.f. U.K. ports. Spot £30 per ton ex store.

POTASSIUM PERMANGANATE.—LONDON: 8½d. per lb. SCOTLAND: B.P. crystals, 8½d. MANCHESTER: Commercial, 8¼d.; B.P., 8¾d.

POTASSIUM PRUSSIATE.—LONDON: 8½d. to 9d. per lb. SCOTLAND: Yellow spot material, 8½d. ex store. MANCHESTER: Yellow, 8¼d.

SALAMMONIAC.—First lump spot, £42 17s. 6d. per ton d/d in barrels.

SODA ASH.—58% spot, £6 per ton f.o.r in bags, special terms for contracts.

SODA, CAUSTIC.—Solid 76/77° spot, £14 10s. per ton d/d station. SCOTLAND: Powdered 98/99%, £17 10s. in drums £18 15s. in casks. Solid 76/77% £14 10s. in drums 70/72% £14 12s. 6d., carriage paid buyer's station, minimum 4-ton lots; contracts 10s. per ton less. MANCHESTER: £12 15s. to £14 contracts.

SODA CRYSTALS.—Spot, £5 to £5 5s. per ton d/d station or ex depot in 2-cwt. bags.

SODIUM ACETATE.—£21 to £22 per ton.

SODIUM BICARBONATE.—Refined spot, £10 10s. per ton d/d station in bags. SCOTLAND: Refined recrystallised £10 10s. ex quay or station. MANCHESTER: £10 10s.

SODIUM BICHROMATE.—Crystals cake and powder 4d. per lb. net d/d U.K. discount according to quantity. Anhydrous 5d. per lb. LONDON: 4d. per lb. with discounts for quantities. SCOTLAND: 4d. delivered buyer's premises with concession for contracts. MANCHESTER: 4d. less 1 to 3½% contracts, 4d. spot lots.

SODIUM BISULPHITE POWDER.—60/62%, £16 10s. per ton d/d/ 1-cwt. iron drums for home trade.

SODIUM CARBONATE (SODA CRYSTALS).—SCOTLAND: £5 to £5 5s. per ton ex quay or station. Powdered or pea quality 7s. 6d. per ton extra. Light Soda Ash £7 ex quay, min. 4-ton lots with reductions for contracts.

SODIUM CHLORATE.—2¾d. per lb. LONDON: £29 per ton. MANCHESTER: £29.
SODIUM CHROMATE.—3½d. per lb. d/d U.K.
SODIUM HYPOSULPHITE.—SCOTLAND: Large crystals English manufacture, £9 5s. per ton ex stations, min. 4-ton lots. Pea crystals £15 ex station 4-ton lots. MANCHESTER: Commercial, £9 5s.; photographic, £15.
SODIUM NITRITE.—Spot, £19 to £22 per ton d/d station in drums.
SODIUM PERBORATE.—LONDON: 10d. per lb.
SODIUM PHOSPHATE.—£13 to £15 per ton.
SODIUM PRUSSIATE.—LONDON: 5d. to 5½d. per lb. SCOTLAND: 5d. to 5¾d. ex store. MANCHESTER: 5d. to 6d.
SODIUM SILICATE.—140° Tw. Spot £8 5s. per ton d/d station returnable drums.
SODIUM SULPHATE (GLAUBER SALTS).—£4 2s. 6d. per ton d/d. SCOTLAND: English material £3 15s.
SODIUM SULPHATE (SALT CAKE).—Unground Spot £3 15s. per ton d/d station in bulk. SCOTLAND: Ground quality, £3 5s. per ton d/d. MANCHESTER: £3 2s. 6d.
SODIUM SULPHIDE.—Solid 60/62% Spot, £10 15s. per ton d/d in drums. Crystals Spot £7 15s. per ton d/d in casks. SCOTLAND: For home consumption, Solid 60/62%, £10 5s.; broken 60/62%, £11 5s.; crystals, 30/32%, £8 2s. 6d. d/d buyer's works on contract, min. 4-ton lots. Spot solid 5s. per ton extra. Crystals, 2s. 6d. per ton extra. MANCHESTER: Concentrated solid, 60/62%, £11; commercial, £8.
SODIUM SULPHITE.—Pea crystals spot, £13 10s. per ton d/d station in kegs. Commercial spot £9 10s. d/d station in bags.
SULPHATE OF COPPER.—MANCHESTER: £16 10s. per ton f.o.b.
SULPHUR.—£12 5s. per ton. SCOTLAND: Flowers, £12 10s.; roll, £12; rock, £9. Ground American, £12 ex store.
SULPHUR CHLORIDE.—5d. to 7d. per lb., according to quality.
SULPHUR PRECIP.—B.P. £55 to £60 per ton according to quantity. Commercial, £50 to £55.
VERMILION.—Pale or deep, 5s. to 5s. 3d. per lb.
ZINC CHLORIDE.—SCOTLAND: British material, 98%, £18 10s. per ton f.o.b. U.K. ports.
ZINC SULPHATE.—LONDON and SCOTLAND: £12 per ton.
ZINC SULPHIDE.—1s. to 1s. 2d. per lb.

Pharmaceutical and Fine Chemicals

ACID, CITRIC.—1s. per lb.
ACID, TARTARIC.—11¾d. per lb.
BISMUTH SALTS.—Carbonate, 6s. 6d. per lb.; citrate, 8s. 10d.; nitrate (cryst.), 4s. 4d.; oxide, 10s.; salicylate, 7s. 3d.; subchloride, 9s. 10d.; subgallate, 6s. 11d.; subnitrate, 5s. 8d.
MENTHOL, A.B.R. RECRYST. B.P.—14s. per lb
POTASS. BITARTRATE 99/100% (Cream of Tartar).—80s. per cwt.
ETHYL CINNAMATE.—7s. 6d. per lb.
GERANIOL.—5s. 6d. to 11s. per lb.
HELIOTROPINE.—5s. 9d. per lb.
METHYL ANTHRANILATE.—8s. 6d. per lb.

Essential Oils

ALMOND, FOREIGN, S.P.A.—11s. 6d. per lb.
ANISE.—2s. per lb.
BERGAMOT.—11s. per lb.
BOURBON GERANIUM.—26s. 6d. per lb.
CAMPHOR, WHITE.—100s. per cwt.
CITRONELLA OIL, JAVA.—3s. 2d. per lb.
LEMON.—6s. per lb.
LEMONGRASS.—2s. 3d. per lb.
PEPPERMINT, JAPANESE.—4s. 3d. per lb.
PETITGRAIN.—5s. 6d. per lb.

Intermediates and Dyes

In the following list of Intermediates delivered prices include packages except where otherwise stated:—

ACID, BENZOIC, B.P. (ex Toluol).—1s. 9½d. per lb.
ACID, GAMMA.—Spot, 4s. per lb. 100% d/d buyer's works.
ACID, H.—Spot, 2s. 4½d. per lb. 100% d/d buyer's works.
ACID, NEVILLE AND WINTHER.—Spot, 3s. per lb. 100% d/d buyer's works.
ACID, SULPHANILIC.—Spot, 8d. per lb. 100% d/d buyer's works.
ANILINE OIL.—Spot, 8d. per lb., drums extra, d/d buyer's works.
ANILINE SALTS.—Spot, 8d. per lb. d/d buyer's works, casks free.
BENZALDEHYDE.—Spot, 1s. 8d. per lb., packages extra.
BENZIDINE BASE.—Spot, 2s. 5d. per lb. 100% d/d buyer's works.
o-CRESOL 30/31° C.—£2 6s. 5d. per cwt., in 1-ton lots.
m-CRESOL 98/100%.—2s. 9d. per lb., in ton lots.
p-CRESOL 34.5° C.—1s. 9d. per lb., in ton lots.
DICHLORANILINE.—2s. per lb.
DIMETHYLANILINE.—Spot, 1s. 6d. per lb., package extra.
DINITROBENZENE.—8½d. per lb.
DINITROTOLUENE.—48/50° C., 8½d. per lb.; 66/68° C., 9d. per lb.
DIPHENYLAMINE.—Spot, 2s. per lb., d/d buyer's works.
α-NAPHTHOL.—Spot, 2s. 4d. per lb., d/d buyer's works.
β-NAPHTHOL.—Spot, £75 per ton in 1-ton lots, d/d buyer's works.
α-NAPHTHYLAMINE.—Spot, 11½d. per lb., d/d buyer's works.
β-NAPHTHYLAMINE.—Spot, 2s. 9d. per lb. d/d buyer's works.
o-NITRANILINE.—5s. 10d. per lb.
m-NITRANILINE.—Spot, 2s. 7d. per lb. d/d buyer's works.
p-NITRANILINE.—Spot, 1s. 8d. per lb. d/d buyer's works.
NITROBENZENE.—Spot, 5d. per lb.; 5-cwt. lots, drums extra.
NITRONAPHTHALENE.—9d. per lb.
SODIUM NAPHTHIONATE.—Spot, 1s. 9d. per lb.
o-TOLUIDINE.—Spot, 9½d. per lb., drums extra, d/d buyer's works.
p-TOLUIDINE.—Spot, 1s. 11d. per lb., d/d buyer's works.
m-XYLIDINE ACETATE.—3s. 6d. per lb., 100%.

Coal Tar Products

ACID, CARBOLIC (CRYSTALS).—5½d. to 6¾d. per lb. Crude, 60's 1s. 5¼d. to 1s. 6¼d. per gal. SCOTLAND: Sixties, 1s. 7d. to 1s. 8d.
ACID, CRESYLIC.—99/100, 1s. 7d. per gal.; B.P., 2s. to 2s. 2d.; Refined, 1s 8d. to 1s. 10d.; Pale, 98%, 1s. 6d. to 1s. 7d.; Dark, 1s. 3d. to 1s. 4d. LONDON: 98/100%, 1s 6d. Dark 95/97%, 1s. 4d. SCOTLAND: Pale 99/100%, 1s. 3d. to 1s. 4d.; 97/99%, 1s. to 1s. 1d.; dark 97/99%, 11d. to 1s.; high boiling acid, 2s. 6d. to 3s.
BENZOL.—At works, crude, 8½d. to 9d. per gal. Standard motor, 1s. 3½d. to 1s. 4d.; 90%, 1s. 4d. to 1s. 5d. Pure, 1s. 7d. to 1s. 8d. LONDON: Motor, 1s. 5½d. SCOTLAND: Motors, 1s. 3½d. to 1s. 4½d.; 90%, 1s. 9½d. to 1s. 10½d.
CREOSOTE.—Standard for export, 4¾d. to 5d. nett per gal. f.o.b. for Home, 3¾d. d/d. LONDON: 3d. to 3½d. f.o.r. North; 4d. to 4½d. London. MANCHESTER: 3d. to 4d. SCOTLAND: Specification oils, 3¾d to 4¼d.; washed oil, 4d. to 4½d.; light, 3¾d. to 4¼d.; heavy, 4½d. to 5d.
NAPHTHA.—Solvent, 90/160, 1s. 4d. to 1s. 5d. per gal.; 95/160, 1s. 4½d.; 90/190, 1s. 1d. to 1s. 2d. LONDON: Solvent, 1s. 1½d. to 1s. 2d.; heavy, 11d. to 1s 0½d. f.o.r. SCOTLAND: 90/160, 1s. 3d. to 1s. 3½d.; 90/190, 1s. 1d. to 1s. 2d.
NAPHTHALENE.—Purified crystals, £9 10s. per ton in bags. LONDON: Fire lighter quality, £3 to £3 10s.; 74/76 quality, £4 to £4 10s.; 76/78 quality, £5 10s. to £6. SCOTLAND: 40s. to 50s.; whizzed, 65s. to 70s.
PYRIDINE.—90/140, 3s. 9d. per gal.; 90/160, 4s. to 4s. 6d.; 90/180, 2s. to 2s. 6d. SCOTLAND: 90/160%, 4s. to 5s.; 90/220%, 3s. to 4s.
REFINED COAL TAR.—SCOTLAND: 4¾d. to 5d. per gal.
TOLUOL.—90%, 2s. 1d. to 2s. 2d. per gal.; Pure, 2s. 5d. to 2s. 6d.
XYLOL.—1s. 9d. per gal.; Pure, 1s. 11d.

Wood Distillation Products

ACETATE OF LIME.—Brown, £8 5s. per ton. Grey, £10 10s. to £12. Liquor, brown, 30° Tw., 6d. per gal. MANCHESTER: Brown, £8 10s.; grey, £11 10s.
ACETIC ACID, TECHNICAL, 40%.—£16 10s. to £18 per ton.
ACETONE.—£63 to £65 per ton.
AMYL ACETATE, TECHNICAL.—95s. to 110s. per cwt.
CHARCOAL.—£6 10s. to £11 per ton.
IRON LIQUOR.—24°/30° Tw., 10d. to 1s. 2d. per gal.
WOOD CREOSOTE.—6d. to 2s. per gal., unrefined.
WOOD NAPHTHA, MISCIBLE.—2s. 6d. to 4s. per gal. Solvent, 3s. 9d. to 4s. 9d. per gal.
WOOD TAR.—£2 to £6 per ton.
BROWN SUGAR OF LEAD.—£32 per ton.

Nitrogen Fertilisers

SULPHATE OF AMMONIA.—The export market continues quiet, but the price remains steady at £4 7s. 6d. per ton f.o.b. U.K. port in single bags for August shipment, and £4 10s. per ton for September shipment. In the home market sales have been made at the price of £5 5s. per ton delivered in 6 ton lots to farmers' nearest station, but at the moment buying is small.
IMPORTED NITRATE OF SODA.—Last season's price of £9 per ton delivered in 6 ton lots to farmers' nearest station remains in force.
NITRO-CHALK.—The price remains unchanged at £7 5s. per ton delivered in 6 ton lots.

Latest Oil Prices

LONDON, AUGUST 17.—LINSEED OIL was firm. Spot, small quantities, £17; Aug. £14 7s. 6d.; Sept.-Dec., £1 2s. 6d.; Jan.-April, £16; May-Aug., £16 12s. 6d. per ton, naked. RAPE OIL was steady. Crude extracted, £28 10s.; technical refined, £30 10s. per ton, naked, ex wharf. COTTON OIL was steady. Egyptian crude, £22 10s.; refined common edible, £25 10s.; and deodorized, £27 10s. per ton, naked, ex mill. TURPENTINE was steady. American spot, 60s. 6d. per cwt.
HULL.—LINSEED OIL, spot closed at £15 per ton; Aug., £14 10s.; Sept.-Dec., £15; and Jan.-April, £15 12s. 6d. COTTON OIL, Egyptian, crude, spot, £23 10s.; edible, refined, spot, £26; refined, £26; deodorized, £27, naked. PALM KERNEL OIL, crude, f.m.q., spot, £22 10s. GROUNDNUT OIL, crushed extracted, spot, £32; deodorized, £36. RAPE OIL, crushed extracted, spot £23 10s.; deodorized £26 10s. per ton. COD OIL, 15s. 6d. per cwt. CASTOR OIL, pharmacy, spot, 41s. 6d.; spot, 61s. 6d. per cwt.

Inventions in the Chemical Industry

Specifications Accepted and Applications for Patents

THE following information is prepared from the Official Patents Journal. Printed copies of Specifications Accepted may be obtained from the Patent Office, 25 Southampton Buildings, London, W.C.2, at 1s. each. The numbers given under "Applications for Patents" are for reference in all correspondence up to the acceptance of the Complete Specification.

Specifications Accepted with Dates of Applications

PROCESS FOR MANUFACTURING ORGANIC MANURE. J. Kaiser and Dr. E. Sauer. February 25, 1931. 377,990.

HORMONE, AND PROCESS OF OBTAINING THE SAME. President and Board of Trustees of St. Louis University. Oct. 6, 1930. 377,991.

PROCESS OF REMOVING SOLVENTS FROM PLASTIC COLLOIDS. Meigs, Bassett, & Slaughter, Inc. Mar. 4, 1930. 378,052.

REFINING OF HYDRO-CARBON LIQUIDS. Anglo-Persian Oil Co., Ltd., and A. E. Dunstan. Mar. 4, 1931. 378,010.

MANUFACTURE OF NITRIC ACID FROM AMMONIA. H. Frischer. Mar. 23, 1931. 378,011.

MANUFACTURE AND PRODUCTION OF GLASS. J. Y. Johnson (*I. G. Farbenindustrie*). Mar. 26, 1931. 378,012.

OXIDATION OF AMMONIUM SULPHITE IN AQUEOUS SOLUTION. W. C. Holmes and Co., and H. J. Hodsman. Mar. 31, 1931. 377,950.

HEAT-INTERCHANGERS FOR HEATING AND COOLING FLUIDS. C. W. Stancliffe. Apr. 1, 1931. 377,962.

MANUFACTURE OF ARSENIC COMPOUNDS. W. W. Groves (*I. G. Farbenindustrie*). Apr. 2, 1931. 377,904

PROCESS FOR OBTAINING OR CONCENTRATING GERMANIUM. V. M. Goldschmidt. Mar. 27, 1931. 378,017.

PREPARATION OF COLLOIDAL SUSPENSIONS OF SOLIDS. Einstein's Electro Chemical Process, Ltd., and P. G. M. A. Pigache. Apr. 24, 1931. 377,995.

PRODUCTION AND USE OF FINELY DISPERSED INTERMEDIATES AND DYESTUFFS. Imperial Chemical Industries, Ltd., S. W. Dunworth, and J. S. Wilson. Apr. 27, 1931. 378,034.

MANUFACTURE AND PRODUCTION OF VALUABLE DERIVATIVES OF HIGHER FATTY ACIDS. J. Y. Johnson (*I. G. Farbenindustrie.*) Apr. 29, 1931. 378,002.

METHOD AND APPARATUS FOR THE PRODUCTION OF EMULSIONS, ESPECIALLY OF SUCH FROM MILK AND FAT OR OIL. A. Hoffman. Apr. 30, 1931. 378,066.

CATALYZER FOR THE OXIDATION OF AMMONIA WITH OXYGEN OR WITH GASES CONTAINING OXYGEN. I. W. Cederberg. Apr. 30, 1930. 377,974.

MANUFACTURE OF COMPOSITIONS AND SOLUTIONS FOR USE IN DYEING AND TEXTILE PRINTING. Imperial Chemical Industries, Ltd., M. Mendoza and A. G. Murray. May 1, 1931. 377,978.

PROCESS OF PREPARING 4[1]-SULPHO-O-BENZOYL-BENZOIC ACID. I. Gubelmann, H. J. Weiland and O. Stallman. May 1, 1931. 377,981.

CENTRIFUGAL HYDRO-EXTRACTORS. Baker Perkins, Ltd., W. G. Milligan and H. Simpson. May 1, 1931. 377,982.

MANUFACTURE OF CELLULOSE ESTERS. W. W. Groves (*I. G. Farbenindustrie.*) May 5, 1931. 378,044.

PROCESS FOR DYEING WITH THE RESERVING OF WOOL OR SILK. A. Carpmael (*I. G. Farbenindustrie.*) May 5, 1931. 378,045.

MANUFACTURE OF EMULSIFYING AND WETTING AGENTS. Imperial Chemical Industries, Ltd., R. P. McGlynn, and W. Todd. May 6, 1931. 378,075.

STABILISATION OF CHLORINATED HYDROCARBONS. J. Savage, A. V. Pitter and Imperial Chemical Industries, Ltd. May 7, 1931. 378,084.

PRODUCTION OF δ-LACTONES OF DECAHYDRONAPHTHALENES. C. H. Boehringer Sohn. May 17, 1930. 378,088.

PROCESS FOR THE PRODUCTION OF δ-LACTONES OF HEXAHYDROBENZENE AND ITS HOMOLOGUES. C. H. Boehringer Sohn. June 25, 1930. 378,095.

PROCESS FOR TREATING NATURAL AND ARTIFICIAL CELLULOSE FIBRES WITH ALKALI. Chemische Fabrik Vorm. Sandoz. July 30, 1930. 378,194.

CONSERVATION OF THE ACTIVITY OF A VACCINE IN A FATTY AND ANTISEPTIC MEDIUM. P. Anselm. July 31, 1931. 378,108.

PRODUCTION AND PURIFICATION OF LIGHT OILS BY THE DISTILLATION OF FUEL. C. Still. Aug. 29, 1930. 378,217.

OBTAINING BY-PRODUCTS FROM COAL-DISTILLATION GASES. C. Still. Aug. 30, 1930. 378,222.

PROCESS FOR IMPROVING THE ACTION OF ALKALINE MERCERIZING LIQUORS UPON CELLULOSIC FIBRES. I. G. Farbenindustrie. Sept. 24, 1930. 378,223.

SIMULTANEOUS RECOVERY OF PHOSPHOROUS OR OXIDES OF PHOSPHORUS AND MIXTURES OF HYDROGEN AND CARBON-MONOXIDE. C. Padovani. Sept. 5, 1930. 378,226.

MANUFACTURE OF PHOTOGRAPHIC SENSITIZERS AND DESENSITIZERS. I G. Farbenindustrie. Sept. 20, 1930. 378,239.

MANUFACTURE OF RUBBER CHLORINATION PRODUCTS. New-York Hamburger Gummi Waaren Cie. Nov. 10, 1930. 378,272.

PROCESS FOR KILLING OR ELIMINATING FLIES AND PREPARATIONS THEREFOR. I. G. Farbenindustrie. Dec. 13, 1930. 378,300.

APPARATUS FOR CARRYING OUT ROASTING, SINTERING, CALCINING, AND THE LIKE OPERATIONS. A. G. Metallges. Feb. 13, 1931. 378,334.

PRODUCTION OF A CLEANING-PASTE FOR DISSOLVING AND ABSORBING DIRT, FAT, AND THE LIKE. H. Winter, M. Horbert, and G. Schwarze. Feb. 11, 1931. 378,335.

APPARATUS FOR CRYSTALLIZING SUGAR AND OTHER SOLUTIONS BY EVAPORATION OR COOLING. Werkspoor Naamlooze Vennooschap. February 28, 1931. 378,341.

PRODUCTION OF THIN SKINS OR FILMS OF CELLULOSE AND CELLULOSE DERIVATIVES. J. P. Bemberg, A. G. Feb. 20, 1931. 378,342.

MANUFACTURE OF MIXTURES OF SODIUM PHOSPHATES FOR TREATING BOILER WATERS AND OTHER AQUEOUS LIQUORS. R. Haddan (*Federal Phosphorous Co.*). March 4, 1932. 378,345.

APPARATUS FOR CONVEYING PLASTIC MATERIAL. A. H. Stevens. (*Phosphate Acidulating Corporation*). Nov. 7, 1931. 378,364.

Complete Specifications open to Public Inspection

MANUFACTURE OF PARAFFIN WAX OF HIGH MELTING-POINT. A. J. Gentil. Aug. 4, 191. 25315/32.

PROCESS FOR THE MANUFACTURE OF QUINOLINE-8-AZO COMPOUNDS OF THE QUININE SERIES. I. G. Farbenindustrie. Aug. 8, 1931. 10392/32.

TREATMENT OF THREADS AND FILAMENTS OF CELLULOSE ACETATE OR OTHER ORGANIC DERIVATIVES OF CELLULOSE. Soc. Pour La Fabrication De La Soie Rhodiasteta. Aug. 8, 1931. 14997/32.

PROCESS FOR PRODUCTION OF LUBRICATING-OIL. Union Oil Co. of California. Aug. 4, 1931. 19613/32.

PROCESS FOR THE MANUFACTURE OF HEAVY METAL COMPOUNDS OF THIO-SUBSTITUTED CARBOHYDRATES. Schering-Kahlbaum, A. G. Aug. 3, 1931. 19617/32.

PROCESS FOR THE MANUFACTURE OF COMPLEX COMPOUNDS OF THIO-SUBSTITUTED CARBOHYDRATES. Schering-Kahlbaum Akt.-Ges. Aug. 3, 1931. 2093/32.

PROCESSES FOR PRODUCING PRACTICALLY PURE CELLULOSE ("ALPHA-CELLULOSE") FROM RAW CELLULOSE OF ANY ORIGIN. F. C. Palazzo and F. Palazzo. Aug. 4, 1931. 20462/32.

PROCESS FOR PROTECTING MAGNESIUM AND ALLOYS THEREOF AGAINST THE ACTION OF POLYHYDRIC ALCOHOLS OR MIXTURES OF SAME WITH WATER. I. G. Farbenindustrie. Aug. 6, 1931. 21329/32.

TREATMENT OF SILK FIBROIN FOR AQPEOUS SOLUTIONS THEREOF. I. G. Farbenindustrie. July 31, 1931. 21668/32.

PROCESS FOR THE DECOMPOSITION OF SILICEOUS ALUMINIFEROUS MINERALS. Chemische Fabrik Buckau. Aug. 5, 1931. 21835/32.

MACHINES FOR TREATING CRYSTALLISED MARGARINE MASSES AND OTHER SOLID FATS. C. Hildebrandt-Sprensen. Aug. 5, 1931. 21907/32.

Amended Specification Published

HALOGENATION OF ANTHRAQUINONE AND ITS DERIVATIVES. Imperial Chemical Industries, Ltd., and others. 364,141.

Applications for Patents

REFINING HYDROCARBON OILS. Sinclair Refining Co. July 26. (United States, Aug. 1, '31.) 21089.

MANUFACTURE OF DYESTUFFS CONTAINING CHROMIUM. Society of Chemical Industry in Basle. July 27. (Switzerland, Sept. 29, '31.) 21229.

CONVERSION OF OLEFINES INTO ALCOHOLS. H. M. Stanley. July 27. 21196.

MANUFACTURE OF CONDENSATION PRODUCTS OF THE ANTHRACENE SERIES. A. Carpmael. (*I. G. Farbenindustrie Akt.-Ges.*). August 9. 22330.

PRODUCTION OF METHYL METHACRYLATE. J. W. C. Crawford. August 12. 22673. 22674.

PRODUCTION OF HYPOCHLORITE OF CALCIUM SOLUTIONS. Deutsche Solvay-Werke Akt.-Ges. August 12. (Germany, August 14, '31.) 22670.

CALCINATION OF GYPSUM. E. L. Francis (*Gypsum Lime and Alabastine, Canada, Ltd.*). August 13. 22759.

MANUFACTURE OF WATERSOLUBLE PHOSPHATE. J. P. Fraser. August 12. 22645.

MANUFACTURE OF CHROME YELLOW COLOURS. J. Y. Johnson (*I. G. Farbenindustrie Akt.-Ges.*). August 8. 22209.

MANUFACTURE OF GLASS. J. Y. Johnson (*I. G. Farbenindustrie Akt.-Ges.*). August 8. 22210. 22211.

MANUFACTURE OF CARBOXYLIC ACID AMIDES. J. Y. Johnson (*I. G. Farbenindustrie Akt.-Ges.*). August 8. 22212.

MANUFACTURE OF NITROSO COMPOUNDS OF COBALT. J. Y. Johnson (*I. G. Farbenindustrie Akt.-Ges.*). August 11. 22521.

TREATMENT OF METALS WITH ACID. I. G. Farbenindustrie Akt.-Ges. August 11. (Germany, August 14, '31.) 22529.

From Week to Week

THE CHILEAN GOVERNMENT has granted 20,000,000 pesos (£500,000 at par) to the independent nitrate producers.

DR. E. F. BURTON, professor of physics at the University of Toronto, has been appointed head of the physics department and director of the physics (McLennan) laboratory in succession to Dr J. C. McLennan, who recently retired.

DR. G. C. CLAYTON, M.P., who has been a director of the Liverpool Gas Co. since 1922, has been appointed chairman in the place of the late Sir Henry Wade Deacon. Dr. Clayton is M.P. for the Wirral Division, and a director of Imperial Chemical Industries, Ltd., and Power Gas Corporation, Ltd. He is president of the Institute of Chemistry of Great Britain and Ireland, representative of the chemical industry on the advisory council of the Board of Trade, and a Justice of the Peace. Mr. Alfred Tyrer, the present vice-chairman, who has held that office for eleven years, will continue in that capacity.

AN EXPLOSION OCCURRED at the Royal Naval Cordite Factory, Holton Heath, near Wareham (Dorset), last week, but no one was seriously injured. Four men who were working near by were taken to the factory hospital, but were found to be suffering only from slight shock and were allowed to go home. The explosion occurred in the cordite pressing shed, where about twenty pounds of cordite blew off the roof of the shed. Considerable alarm was caused in the neighbourhood. In June last year ten men were killed and several injured in an explosion at the factory, which employs between two hundred and three hundred workers.

A DEMONSTRATION OF THE CHEMICAL DE-SCALING in a water-tube boiler, stated to mark the introduction of a new scientific discovery to Scotland, was recently completed at the Burnbank Chemical Works, Paisley, of William Forrest & Son, Ltd. Following a preliminary inspection of the empty boiler at the beginning of the week, the boiler was filled with water to the working level along with a quantity of the chemical de-scaler, and this liquid was allowed to remain in the boiler until yesterday, when the boiler was again emptied. An official inspection was then made of the boiler, which was found to be cleaned to the metal surface. The feature of this method of treatment, it is claimed, is that while it dissolves the scale on the boiler the solvent has no effect on the metal.

A SERIOUS FIRE BROKE OUT at the oil refinery of H. Foster and Co., Kirkstall Road, Leeds, on August 11, and but for prompt warning to the City Fire Brigade the blaze might have reached alarming dimensions. At one time it was feared that one of the stills would explode, and at another it was reported that a neighbouring oil manufacturer's premises had become involved. Thirty firemen were engaged for three hours in fighting the fire, which started in the condensing plant. The firemen had to contend with a flow of green oil (in which they waded ankle deep) and suffocating fumes. Desperate efforts were made to get the flames under control, and to prevent them spreading to the adjacent oil manufacturing premises of Adolph Hess and Brother, Ltd. There were something like 15,000 gallons of crude oil in the condensing plant at the time of the outbreak. Several firemen were overcome by the fumes, two being in a state of collapse, but no other people were involved.

DAMAGE AMOUNTING TO £15,000 was done by a fire at Thurmaston, near Leicester, on August 13, when the premises of Peptine-Maltine, Ltd., manufacturers of malt extract, were burnt out.

A TANK CONTAINING 18,000 GALLONS OF BOILING TAR burst at Dover Gas Works on August 12. The tank, which is about 30 ft. high and 8 ft. in diameter, is situated near the works wall, and the wall was broken down for a distance of 30 feet, the tar rushing out into the street. The tar was valued at £900.

RECENT WILLS include.—James Anderson Morrice, farina starch and gum manufacturer, late of Glasgow, and of James Anderson and Co., London, personal estate in Great Britain, £127,523; William Henry Butler, of The Priory, Westbury-on-Trym, Bristol, late of William Butler and Co., chemical manufacturers, of Bristol, gross estate, £132,718.

THE FIRST OF A SERIES OF GATHERINGS in connection with the forthcoming joint autumn meeting of the Iron and Steel Institute and the Institute of Metals will be held at the Institution of Mechanical Engineers' Storey's Gate, Westminster, S.W.1, on Monday, September 12, at 8 p.m., when Dr. H. J. Gough, superintendent of the Engineering Department, National Physical Laboratory, will deliver the annual autumn lecture of the Institute of Metals on "Corrosion Fatigue in Metals." The lecturer will deal with both steel and non-ferrous metals. Visitors are invited to the lecture; cards of admission are obtainable from Mr. G. Shaw Scott, 36-38 Victoria Street, London, S.W.1.

RECORD APPLICATIONS FOR SPACE at next February's British Industries Fair are announced by the Department of Overseas Trade. Eight hundred and thirty-three exhibitors have already applied for 311,027 square feet at Olympia and at the Court of Honour at the White City. The figure is an increase of 88,000 square feet compared with the corresponding period a year ago, and it is 2,000 square feet greater than the space occupied by the Fair in February. In the druggists sundries section the area of 8,199 square feet already applied for is almost equal to the total area occupied at the last Fair (8,262 sq. ft.). One hundred and twenty seven exhibitors have applied for 74,134 square feet of space in the textile section at the White City, and Birmingham reports that ninety per cent. of the available space at Castle Bromwich is now let.

A WARNING TO BRITISH EXPORTERS is contained in a report issued by the Department of Overseas Trade on economic and trade conditions in Latvia. "A British exporter, in order to secure a sale of his goods," it is stated, "must now not only ascertain the solvency of the consignee—a most important point in Latvia nowadays—but also ascertain whether that consignee has secured a licence for the importation of the goods ordered and a permit to pay for them when received." Business with Latvia must necessarily entail risks for foreign firms who are unaware of the peculiar trading methods of the country. It should be remembered, however, that an excess of middlemen, the grant of liberal credit even to small and newly established merchants, together with the existence of a number of agents of mediocre standing, are factors which make it essential for United Kingdom exporters to institute most careful inquiries regarding the solvency of customers if bad debts are to be avoided. Litigation is lengthy and costly.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

Cheshire United Salt Co., Ltd., London, E.C. (M. 20/8/32.) Registered August 9, £10,000 debentures, part of amount already registered; general charge (subject, &c.). *£9,025. October 23, 1931.

Satisfaction

Malehurst Barytes Co., Ltd. (M.S. 20/8/32.) Satisfactions registered August 3, of debentures registered May 14, July 15 and November 5, 1926, March 11, April 27, May 16, June 20, July 11 and October 14, 1927, March 3, August 21 and September 8, 1928, January 2, March 13, April 9 and July 11, 1929, April 29, September 17 and November 3, 1930, and February 17, 1931.

County Court Judgments

[NOTE.—The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be for damages or otherwise, and the result of bona-fide contested actions. But the Registry makes no distinction of the cases. Judgments are not returned to the Registry if satisfied in the Court books within twenty-one days. When a debtor has made arrangements with his creditors we do not report subsequent County Court judgments against him.]

Devons Chemical Co. (sued as a firm), 223 Devons Road, Bow, E., manufacturing chemists. (C.C. 20/8/32.) £16 3s. 9d. June 16.

Ham Frith Chemical Co., Ltd., Highbury Works, Gibbins Road, Stratford, manufacturing chemists. (C.C. 20/8/32.) £21 11s. 4d. June 14.

Taylor Products (Southport), Ltd., 135a Linaker Street, Southport, manufacturing chemists. (C.C. 20/8/32.) £20 19s. 8d. July 12.

New Chemical Trade Marks

Opposition to the Registration of the following trade marks can be lodged up to September 3, 1932.

Scalite. 531,228. Class 1. Preparations for the prevention and removal of scale in boilers, pipes, condensers and similar water containers. Ernest William George Wedge, 27 Langdale Road, Bootle, Liverpool.

Crexone. 532,979. Class 1. Chemical substances used in manufactures, photography or philosophical research, and anti-corrosives, Rex Campbell & Co., Ltd., 7 Idol Lane, Eastcheap, London, E.C.3.

Crexyl. 532,980. Class 1. Chemical substances used in manufactures, photography or philosophical research, and anti-corrosives. Rex Campbell & Co., Ltd., 7 Idol Lane, Eastcheap, London, E.C.3.

Chemical Trade Inquiries

Abstracted from the "Board of Trade Journal." Names and addresses may be obtained from the Department of Overseas Trade (Development and Intelligence), 35 Old Queen Street, London, S.W.1 (quote reference number).

Canada.—A branch in Lindsay, Ontario, of a well-known United Kingdom firm of manufacturing chemists are prepared to handle non-competitive drug lines for United Kingdom manufacturers. (Ref. No 205.)

Canada.—A firm in Toronto manufacturing druggists' glassware are prepared to represent United Kingdom manufacturers of druggists' sundries and other lines selling direct to the drug trade throughout the Dominion, presumably on a commisson basis (Ref. No. 209.)

South Africa.—H.M. Trade Commissioner at Johannesburg reports that the South African Railways and Harbours Administration is calling for tenders (Tender No. 2077), to be represented in Johannesburg by September 26, 1932, for the supply of 5,090 gallons of machine oil. (Ref. B.X. 7393.)

Poland.—A firm of agents established in Warsaw desires to obtain the representation for Poland of United Kingdom exporters of pharmaceutical and industrial chemicals. (Ref. No. 223.)

South Africa.—H.M. Senior Trade Commissioner in South Africa reports that the South African Railways and Harbours administration is calling for tenders (Tender No. 2081), to be presented in Johannesburg by October 10, 1932, for the supply of 53½ tons of leadless white paint in paste. (Ref. BX. 7392.)

France.—A firm established at Loos wishes to obtain the representation of United Kingdom manufacturers of industrial chemicals on a commission basis. (Ref. No. 218.)

Mexico.—An agent in Mexico City desires to obtain the representation, on a commission basis, of United Kingdom manufactures of industrial and fine chemicals and drugs. (Ref. No. 230.)

Company News

Du Pont de Nemours & Co.—The annual dividend rate has been reduced from $3 to $2.

Triplex Safety Glass Co., Ltd.—A dividend of 10 per cent., less tax, for the year to June 30 last, is announced. This is the same as in the previous twelve months.

Bradford Dyers' Association, Ltd.—No interim dividend is recommended on the ordinary stock. The directors add that although, trading during the half-year to June 30 last shows an improvement compared with the corresponding period of 1931, the debenture interest and the 5 per cent. preference stock dividend, paid July 1 last, will require to be provided out of reserves. No dividend was paid on the ordinary stock in respect of 1931, there having been a loss, after charging £190,379 for depreciation, of £12,215, to meet the preference dividend, the balance of the dividend equalisation reserve of £122,920 was transferred to profit and loss account.

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